RADZWICKI, K., doc.

Development of continuous steel casting based on data for the years 1960 and 1961. [illegible] '62.

RADZWICKI, K., doc.

Technical progress in the electric process based on data taken from writings published during the years 1960 and 1961. Hutnik P 29 no.7/8:293-295 Jl-Ag '62.

RADZWICKI, K., doc.

Development of the steel industries (Martin and electrical processes) in the light of the technological literature for the years 1959 - 1960. Hutnik P 28 no.7/8:295-298 Jl-Ag '61.

RADZWICKI, Kazimierz, doc. mgr inz.

Development of electric slag steel remelting and the quality of obtained ingots and semifinished products. Wiad hut 19 no.3:66-70 Mr '63.

RADZWICKI, Kazimierz, doc. mgr inz.

Possibilities and ways of Polish production of railway rails of higher strength and durability. Wiad hut 18 no.11:339-342 N '62.

P/043/62/000/002/001/001
D001/D101

AUTHOR: Radźwicki, Kazimierz, Docent, Master of Engineering

TITLE: Acceleration of metallurgical reactions in steel bath by injection of pulverized substances or mixing with slag

PERIODICAL: Wiadomości hutnicze, no. 2, 1962, 40-42

TEXT: The article is a brief, selective review of novel principles in steel refining, all of which effect an increase in the contact area between molten steel and slag or other reagents. Some of the methods are frequent vigorous stirring, simultaneous tapping of steel and slag, or discharge of steel into ladles already charged with liquid synthetic slag. Another recently developed method employs a jet of inert or active gas to force into the metal bath pulverized substances such as chalk, slag or carbon. The different reactions that take place depend on the type of powder used and are characterized as follows: 1) The powder does not melt or dissolve in the metal bath; the reaction product is of solid stuff. The method is applied for desulfurization by means of finely pulverized chalk, sometimes with an addition of reducing metals like aluminum or magnesium. 2) An active substance like pulverized slag, usually injected in slight excess, melts in the metal

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Acceleration of metallurgical ....

bath and the reaction products dissolve in droplets of molten slag. 3) Injection of pulverized reducing substances of alloying or carburizing materials into the metal bath by means of an inert gas blast. The technique is far more effective than conventional procedures. 4) Both the pulverized substance and carrier gas can participate in the reaction; the product is in a liquid state. The reaction activity can be controlled by gas-powder ratio. A good example can be observed in refining pig iron by injection of pulverized chalk or ore in an oxygen blast; oxidized silicon and phosphorus form stable compounds with chalk. In addition, undesired impurities like C, Si, Mn, and P are bonded by excess oxygen. Pulverized carbon makes for a fast carburization of steel. The Soviet scientist Z. M. Kudryavtsev [Ref. 5: Stal, vol. 21, no. 5, 1961. 464-467] tells how to calculate and design a nozzle for injection of pulverized substances into the metal bath. There are 2 Soviet-bloc and 3 non-Soviet-bloc references.

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RADZWICKI, Kazimierz, doc. mgr inz.

Decline of the open-hearth process? Wiad hut 16 no.1:15-17 Ja '60.

1. Instytut Metalurgii Zelaza, Gliwice.

RADZWICKI, Kazimierz, doc. mgr inz.

Degassing of liquid steel and selection of the most appropriate way of doing it. Wiad hut 16 no.11:342-345 N '60.

P/039/61/000/005/001/001
D001/D101

AUTHOR: Radźwicki, Kazimierz, Docent

TITLE: Attempts of electro-slag steel melting on a laboratory scale

PERIODICAL: Hutnik, no. 5, 1961, 192-196

TEXT: The article describes experimental steel scrap melting at the laboratory of the Instytut Metalurgii Żelaza (Institute of Iron Metallurgy) in Gliwice. The purpose of this work was to examine melting conditions while using different kinds of start-up and reducing slags. The method of electro-slag melting was originally worked out at the Institut Elektrosvarki im. Ye. O. Patona (Institute of Electric Welding im. Ye. O. Paton) in Kiev. The method is used on an industrial scale at the Dneprospetsstal metallurgical plant in a one-phase electric arc furnace with a consumable electrode made of scrap steel. Drops of melt are purified while passing through a layer of molten and highly superheated synthetic slag. During this passage about 50% of sonims and 50% of the sulfur content in steel are

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Attempts of electro-slag...

removed. Steel ingots thus obtained have a fine structure and improved forging properties. Forged, rolled or cast rods, or siphon cores can be used as consumable electrodes in this process. It takes 1 hour to produce a 200 kg ingot; electrode consumption is given as 1.06-1.20 tons per ton of ingot. The method is costly (about 1,300 rubles per ton) and is applied only for making special, very high grade steel. This process was repeated on a laboratory scale at the Institute of Iron Metallurgy in order to test various sorts of synthetic slags. The installation was designed by the Institute's staff and consisted of a copper crystallizer 120 m high [Abstracter's note: This is an obvious misprint and should read 120 mm] and 50 mm in diameter; the consumable electrode had a diameter of 18-25 mm. The installation was put into operation in March 1960. Following synthetic slags were tried out: the start-up slag with good conductivity to set off the electric arc and a composition of 65% TiO_2, 30% Al_2O_3 and 5% CaO. Fine steel filings were added to this mixture at the ratio of 40%:60% by weight, eventually altered to 50%:50%. The four versions of reducing slag consisted of: a) 65% CaF_2, 30% Al_2O_3,

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5% CaO; b) 70% CaF_2, 30% Al_2O_3; c) 70% Al_2O_3, 30% CaF_2; d) 80% CaF_2, 20% Al_2O_3. The consumable electrode was made of ŁH15 bearing steel scrap. The experiment was performed 10 times using alternately all four reducing slags. The best results were achieved with the slag under d) above which gave a uniformly smooth ingot. The composition of reducing slag is decisive for ingot shape and quality. The consumable electrode consisted of 1.08% C, 0.36% Mn, 0.26% Si, 0.017% P, 0.016% S and 1.06% Cr. Average sonim contamination of the electrode approached the Diergarten scale standard No. 1.07.02. Ingots obtained with reducing slag under d) above contained 0.98-0.99% C, 0.30% Mn, 0.24-0.25% Si, 0.018-0.019% P, 0.011% S and 1.05% Cr. Their sonim contamination approached Diergarten scale standard No. 1.07.01. Results of these experiments call for confirmation on an industrial scale. Master Engineer H. Żakowa and Master Engineer J. Rytych, both of the IMŻ, are mentioned for their cooperation in this study. There are 4 photos and 3 Soviet references.

ASSOCIATION: IMŻ (Institute of Iron Metallurgy), Gliwice.

P/039/60/000/009/006/010
A221/A026

AUTHORS: Radźwicki, K., Docent; Grobicki, W., Docent; - Masters of Engineering

TITLE: Novelties From the Field of Metallurgy. Steel Industry. The Progress of Vacuum Metallurgy in World Iron Metallurgy on the Basis of 1959 Literature

PERIODICAL: Hutnik, 1960, No. 9, pp. 348 - 354

TEXT: This article is divided into two parts, with sub-titles: a) degassing of liquid steel in vacuum, b) melting and pouring of steel in vacuum. The author selected 34 of the most important works from the 1959 world literature dealing with problems of steel degassing and presents a short résumé of each. Sokolov and Oyks (Ref. 1) produced an indicating method, allowing for a quantitative valuation of liquid steel degassing procedure. By applying this method, they found that 80% of gas escapes during the first 3 - 4 min from the ladle after it was placed in a vacuum chamber. Liquid steel convection movements in the ladle contribute to mixing and better degassing. Samarin and Novik (Ref. 2) compare Bessemer and openhearth steel properties. The former is of

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Novelties From the Field of Metallurgy. Steel Industry. The Progress of Vacuum Metallurgy in World Iron Metallurgy on the Basis of 1959 Literature

inferior quality because of P, S, N and O content. By degassing Bessemer steel in vacuum, 77.5% of oxygen, 52.3% of hydrogen, but only 10 - 15% of nitrogen escape. The quality of steel has improved, especially its shock resistance at low temperatures. Antropov and Guryevich (Ref. 8) investigated the influence of degassing on electrical steel properties. EI 72 steel tends to form much less of internal capillary cracks after degassing and, therefore, the amount of scrap dropped by 50%. After degassing it contained 30 - 50% less hydrogen and 20 - 30% less oxygen. Degassing of steel during the crystallization period in the mold deteriorates its structure and contributes to shrinkage cavities formation. K. Radźwicki (Ref. 21) presented the results of investigations carried out at the Instytut Metalurgii Żelaza (Iron Metallurgy Institute) in Gliwice, on forging properties of steel with high nickel content. Ingots from degassed steel showed better forging properties and less transcrystallization. These experiments will be repeated on industrial scale. Pryanishnikov (Ref. 23) discusses the trial smelting of transformer steel in vacuum-induction furnace of 150 kg capacity. It was found that transformer-steel quality is better if the

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charge melts in atmospheric conditions and only working and deoxidation of same takes place in vacuum. Pouring of this steel should be carried out rather in a protective atmosphere and not in a vacuum; on the other hand, addition of FeSi should be done in vacuum and after addition the melt should be kept under vacuum for about 10 min. Pressure forming and magnetic properties of steel prepared in vacuum were better than in conventional steel. Shabanov (Ref. 24) explains some problems connected with steel smelting in arc ovens with a melting electrode, and he produces a formula for the calculation of the ratio between electrode and crystallizer diameters. He also found that a) current density should be adjusted with reference to the electrode diameter, b) metal losses diminish with increased electrode diameter, c) the content of alloy components may vary within a wide range, d) content of oxygen in steel molten at a pressure of 1 Tr or less,drops 2.5 times or more. Byelanchkov and Gryigorash (Ref. 32) examined the influence of various technological factors on degassing of steel melted in vacuum-arc-ovens in crucibles of 2 and 7 kg capacity. Increased melting speed acts adversely on hydrogen and advantageously on oxygen and nitrogen escape.

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The optimum ratio of electrode-to-crucible diameter was established to be: D ÷ d = 0.77. An article under the title "Rolling Ways for Extension of Service Life of Heavy Type RR Rails in USSR", written by Doctor of Engineering Danilov, appeared in an official organ of the USSR Ministry of Transportation "Zheleznodorozhnyy Transport" 1960, No. 3. The author states that heavy RR rails R50 and R65, used on heavy traffic lines, proved not to be strong enough, especially on the inner arcs. Rails which should withstand 500 million tons load gross have shown faults already after being exposed to 50 - 60 million tons gross, marked in an official faults register as No. 64 and 82, i.e., metal overflow, wear and small cracks of fatigue type. The author thinks that a radical way to improve the matter is to use a better quality steel for RR rails. For the time being, however, the author suggests a series of temporary measures. 1) To increase the cross slope of rails on the outer bend from 1 : 20 to 1 : 10. This can be done by inserting between the sole-plate and the tie a wedge shaped pad. This might reduce the wearing out of rail heads by 20 - 30%; 2) to relinquish the hitherto applied 1 : 40 cross slope of heavy rails R65 and R75; 3) to clean the rail an-

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Novelties From the Field of Metallurgy. Steel Industry. The Progress of Vacuum Metallurgy in World Iron Metallurgy on the Basis of 1959 Literature

nually and remove metal flow, flakings, etc.; 4) to regenerate rails removed from main RR tracks; 5) to maintain RR tracks. It might be advantageous to reduce the track gauge from 1,524 mm to 1,518 mm; 6) to improve the defectoscopic method of rail examination in situ; ultrasonic defectoscopes as used in metallurgical plants for sheet thickness control can be applied; 7) to reduce the dynamic action of wheels against rails. Investigations in the direction of improving steel quality are going on for several years, but without any positive results. They are: a) hardening the whole length of rails, particularly those for bends, b) investigations on improving steel quality by addition of some imported noble additives, e.g., manganese in relatively large proportions of 12 - 14%. This is an expensive way, but in the long run it might be justified to do it. There are 34 references: 6 Soviet, 1 French, 11 German, 14 English and 2 Polish.

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POL/39-59-7/8-11/24

18(5)
AUTHOR: Radźwicki, K.

TITLE: Comparison of the Technical and Eccnomic Indexes of Arc and Open-Hearth Furnaces

PERIODICAL: Hutnik, 1959, Nr 7-8, pp 315-316 (POL)

ABSTRACT: As the capacity of electric furnaces increases so the cost of producing steel in this manner decreases. Technical literature shows that in the largest electric furnaces (over 100 tons capacity) 520-560 kWh is used up per ton of common carbon steels and 560-580 kWh per ton of steel alloys where oxygen is used in the process. In small furnaces, this cost may reach 700 kWh/t or even more. With the rapid development of electric processes in steel making in recent years, comparative figures are now available. From these it is evident that open-hearth furnaces are cheaper to operate almost in every case, since the cost of their fuel is always smaller than the electric power and electrodes used in electric furnaces. Where the open-hearth furnaces operate on a liquid charge

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Comparison of the Technical and Economic Indexes of Arc and Open-Hearth Furnaces

and the arc furnaces on a solid charge, the difference in costs is fourfold in favor of the open-hearth furnace. This is so despite the fact that the coefficient of heat utilization is 2.5 times smaller for open-hearth furnaces than for electric furnaces. The explanation lies mainly in the fact that electric power is much more expensive than the fuel oil used to fire open-hearth furnaces. On the other hand, it has been found that as the capacity of furnaces increases, this difference tends to disappear. Also an argument in favor of electric furnaces is the fact that the building cost of such a furnace is about 40% lower than the cost of building an open-hearth furnace. Moreover, the quality of ingots obtained from an arc furnace is usually better than from an open-hearth furnace. Again, open-hearth furnaces require lengthier maintenance, firing and banking procedures, electric furnaces being more efficient from the point of view of time-consumption. On the basis of observations made

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Comparison of the Technical and Economic Indexes of Arc and Open-Hearth Furnaces

in the USA in recent years, the author reaches the conclusion, that given large-capacity furnaces, costs of steel production for both types discussed above are almost even and in some cases the same, especially when the furnaces operate exclusively on a solid charge.

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18(5,7) POL/39-59-4-8/14

AUTHOR: Radzwicki, K

TITLE: The Development of Vacuum Metallurgy and Casting in a Sheltered Atmosphere

PERIODICAL: Hutnik, 1959, Nr 4, pp 165-167 (Poland)

ABSTRACT: All metals in the liquid state tend to dissolve gases in varying degrees. This depends on such factors as the properties of the respective metals and gases, the pressures and tempreratures involved and the length of time during which metals and gases are in contact. It may generally be said that the hotter the metals, the more gas it will absorb. This of course has a detrimental influence on its properties as a metals in the solid state. Gases given off during cooling also effects the metals structure, causing blisters, pores, cavities etc. The need to do away with these flaws is all the greater in view of the ever-rising demand for high-quality metals. Vacuum processes have been developed in recent years above

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all in the USA. Table 1 shows expansion in this field from 1957 to 1958. The table gives capacity figures for the three main vacuum processes: degasifying in vacuum chambers, melting and casting in a vacuum, using respectively induction and arc furnaces. Table 2 shows the degree of degasification achieved by these three methods for soft steel and stainless steel respectively. The cheapest of the three methods is the use of a vacuum chamber for degasifying. Even then costs are increased by about 8-9 dollars per ton. The induction furnaces system is the least economic, since the apparatus is expensive and its capacity is relatively small. One economic method is to cast in a sheltered atmosphere, in this case nitrogen which is fairly cheap and readily available. About 0.4 m^3 of this gas are required per ton. Though nitrogen casting is certainly no replacement for the vacuum processes, it at least eliminates surface flaws. There are 2

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tables and 7 references 2 of which are Soviet, 3 English, 1 German and 1 Polish

18(5) POL/39-59-7/8-10/24

AUTHOR: Radźwicki, K.

TITLE: The Life Span of Steel Ingot Moulds

PERIODICAL: Hutnik, 1959, Nr 7-8, pp 314-315 (POL)

ABSTRACT: This is an important problem not only from the economical point of view but also because the expansion of Poland's steel industry requires also the expansion of foundries making ingot moulds. The author notes that ingot moulds in Poland are often produced by foundries which have no experience in this matter and this, of course, has a negative influence on the steel to be cast therein. He calls for constant study of world technical literature in this matter and draws attention to the fact that since 1958 interesting experiments have been made in the USSR in producing ingot moulds from blast furnace crude and from spheroidal graphite cast iron. Experiments carried out in France show that one important factor affecting the life span of ingot moulds is the relationship between their weight and the weight of the ingot. The ideal weight relation-

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ship between mould and ingot is, according to the author, about 1.0 to 1.1. Other experiments carried out in France have shown that another important factor is the Si and Mn content of the mould's cast iron, the ideal proportion being about 2.46 Si to 4.25 Mn. Soviet engineers have reached the following conclusions in this respect: the first sign that the mould is wearing out is the formation of a network of superficial cracks on the internal surface; these cracks are mostly due to tensions caused during cooling; these may be eliminated by giving the moulds a higher Cr and Ni content but this raises the danger of lengthwise cracks in the mould; the best material by far is spheroidal graphite cast iron; moulds may also be made from blast furnace crude which is readily available on the spot and hence production costs are relatively low; finally, the thickness of the mould's walls should be uniform and reinforcing ribs should be added, these structural changes greatly increasing the life span of ingot moulds. There are 10 references, 8 of which are Soviet, 1 French and 1 English.

RADZWICKI, K., doc.

Development of the oxidizing converter process during the years 1959 - 1960. Hutnik P 28 no.7/8:300-303 Jl-Ag '61.

RADZWICKI, K., doc.

Intensification of the open-hearth process in the light of publications issued in the years 1960 and 1961. Hutnik P 29 no.9:349-352 S '62.

RADZWICKI, Kazimierz, doc. mgr. inz.

What type of steel works is the most proper one for the Polish metallurgical industry? Wiad hut 17 no.9:256-259 S '61.

RADZWICKI, Kazimierz, doc. mgr inż.

Advantages obtained by applying the metallurgical blast cupola in plants with incomplete production cycles. Wiad hut 18 no.7/8:204-208 Jl-Ag '62.

18(5)

AUTHOR: Kuliński, Z., Paczuła, B., Mechanical Engineers and Radźwicki, K., Mechanical Engineer, Lotsent

TITLE: Production of Metallic Manganese from Waste Products (Wytwarzanie manganu metalicznego z surowców odpadowych)

PERIODICAL: Hutnik, 1958, Vol 25, Nr 11-12, pp 471-477 (Poland)

ABSTRACT: The shortage of manganese in the world market has been increasing for years. Imports of manganese into Poland are inadequate. This raises the question of the extraction of manganese from manganic muds, which have been a waste product of the pharmaceutical industry. Basically, there exist three methods for the production of metallic manganese: 1) electrothermic, 2) aluminothermic, and 3) electrolytic. The electrothermic method is seldom used. The aluminothermic method consists in the exothermic reduction of manganic oxides with granulated aluminum. Aluminothermic reactions are: $3MnO_2 + 4Al = 3Mn + 2Al_2O_3$

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$3Mn_3O_4 - 8Al = 9\ Mn - 4\ Al_2O_3$

$Q_{(1)}$ = 1147.4 cal/g; $Q_{(2)}$ = 665.1 cal/g. The electrolytic method employs the electrolysis of $MnSO_4$ in the presence of ammonium salts. The Institute of Iron Metallurgy, Gliwice, and the Academy of Mining and Metallurgy carried out research and experiments regarding the enrichment, cleaning and preparation of manganic mud for metallothermic use. While the metallothermic extraction of manganese from pretreated manganic muds did not give a good yield, the results of the metallothermic melting of raw, dried manganic mud were quite satisfactory. A manganese of higher purity was obtained than the standard electrothermic manganese. Although 0.274 kg of granulated aluminum is needed to reduce 1 kg of manganic mud with 42% Mn content, the extracted manganese is cheaper than the imported one. It has been calculated that the Cracow Pharmaceutical Works will yield in the years to come about 1,200 tons of manganic mud, from which 240 tons of metallic manga-

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nese can be extracted. There are 8 tables, 4 graphs and 3 references, 1 of which is Polish, 1 German and 1 Soviet.

ASSOCIATION: Instytut metalurgii żelaza - Gliwice (Institute of Iron Metallurgy, Gliwice)

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PADZIOCH, K.

Possibilities of reducing the use of electric power in arc furnaces. p. 8

HUTNIK. (Panstwowe Wydawnictwa Techniczne) Vol. 26, no. 1, 1959 Katowice, Poland

Monthly List of East European Accession (EEAI) LC, Vol. 8 no . 7, July 1959

Uncl.

18(5)

AUTHOR: Radźwicki, K.

TITLE: Increase in Steel Production by Heating of Deadhead (Zwiększenie uzysku stali przez nagrzewanie nadlewu wlewka)

PERIODICAL: Hutnik, 1958, Vol 25, Nr 11-12, pp 511-512 (Poland)

ABSTRACT: Heating deadheads by means of an electric arc or a gas burner takes too much time and is often impracticable. The simple and cheap method of Khvorinov, used instead at the Soviet "Serp i Molot" works, consists in strewing an exothermic compound on the surface of the ingot and blowing oxygen on it. As a result, the exothermic compound burns on the surface of the deadhead and provides thereby a considerable amount of heat. The following compounds are used: (1) pulverized 75 per cent ferrosilicon 70%, soda saltpeter 20%, chamotte flour 10%; or (2) 75 per cent ferrosilicon 70%, soda saltpeter 20%, siliceous limestone 10%. The grain of the ground ferrosilicon, which is used in the proportion

Increase in Steel Production by Heating of Deadhead

of 1.0 to 1.2 kg per ton of steel, must not exceed 2 mm. The pressure of the oxygen must not be higher than 4 or 5 at; it is blown 2 to 3 minutes. The method of Khvorinov has been used at the "Serp i Molot" works on over 200,000 tons of steel already. The article is based on a report of N.P.Zhetvin, V.P.Tunkov and A.D.Zaytseva in "Stal'", 1957, Nr 7.

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POL/39-25-11-8/26

18(5)
AUTHOR: Kuliński, Z., Paczuła, B., Mechanical Engineers and Radźwicki, K., Mechanical Engineer, Lotsent

TITLE: Production of Metallic Manganese from Waste Products (Wytwarzanie manganu metalicznego z surowców odpadowych)

PERIODICAL: Hutnik, 1958, Vol 25, Nr 11-12, pp 471-477 (Poland)

ABSTRACT: The shortage of manganese in the world market has been increasing for years. Imports of manganese into Poland are inadequate. This raises the question of the extraction of manganese from manganic muds, which have been a waste product of the pharmaceutical industry. Basically, there exist three methods for the production of metallic manganese: 1) electrothermic, 2) aluminothermic, and 3) electrolytic. The electrothermic method is seldom used. The aluminothermic method consists in the exothermic reduction of manganic oxides with granulated aluminum. Aluminothermic reactions are: $3MnO_2 + 4Al = 3Mn + 2Al_2O_3$

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Production of Metallic Manganese from Waste Products

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$Q(1) = 1147.4$ cal/g; $Q(2) = 665.1$ cal/g. The electrolytic method employs the electrolysis of $MnSO_4$ in the presence of ammonium salts. The Institute of Iron Metallurgy, Gliwice, and the Academy of Mining and Metallurgy carried out research and experiments regarding the enrichment, cleaning and preparation of manganic mud for metallothermic use. While the metallothermic extraction of manganese from pretreated manganic muds did not give a good yield, the results of the metallothermic melting of raw, dried manganic mud were quite satisfactory. A manganese of higher purity was obtained than the standard electrothermic manganese. Although 0.274 kg of granulated aluminum is needed to reduce 1 kg of manganic mud with 42% Mn content, the extracted manganese is cheaper than the imported one. It has been calculated that the Cracow Pharmaceutical Works will yield in the years to come about 1,200 tons of manganic mud, from which 240 tons of metallic manga-

Production of Metallic Manganese from Waste Products

nese can be extracted. There are 8 tables, 4 graphs and 3 references, 1 of which is Polish, 1 German and 1 Soviet.

ASSOCIATION: Instytut metalurgii żelaza - Gliwice (Institute of Iron Metallurgy, Gliwice)

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24(8)

AUTHOR: Radźwicki, K.

TITLE: Improvement of Steel by Degassing It in a Vacuum and Pouring It in Protective Atmosphere (Polepszenie jakości stali przed odgazowywanie w próżni oraz odlewanie w atmosferze ochronnej)

PERIODICAL: Hutnik, 1958, Vol 25, Nr 11-12, pp 505-509 (Poland)

ABSTRACT: The article is based on a report by L.M.Novik in the collection of reports "Primeneniye vakuuma v stale-plavilnykh protsessakh", Moscow 1957. Thermodynamic calculations and experience show carbon to be, under atmospheric pressure, a weaker deoxidizer of liquid metal than silicon and aluminum. But carbon has the advantage of yielding gas products separating completely from the metal, and its deoxidizing capacity can be increased 10 times by lowering the outside pressure to 0.1 at, 760 times by lowering it to 1 mm Hg. Deoxidizing steel by carbon in a vacuum can reduce its carbon content to 0.02%, or even to 0.01%. At the same time,

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both hydrogen and nitrogen are separated from steel because their dissolubility in steel is directly proportionate to the square root of the partial pressure of these gases above the metal. As a rule, the degassing of metal in a vacuum chamber lasts 10 to 20 minutes, so the chamber must be operated easily and quickly. The article proceeds to describe various degassing vacuum chambers now in use in the Soviet Union. After degassing in a vacuum, unkilled steel contains 4 to 10 times less oxygen than undegassed unkilled steel, or about as much oxygen as ordinary killed steel contains (0.0044 to 0.0053% O). The nitrogen content of vacuum-degassed unkilled steel amounts to 30-50% as compared with the nitrogen content before degassing. Ingots of vacuum-degassed unkilled steel are similar to ingots of killed steel in structure and degree of heterogeneity. converted (Bessemer) steel has a low impact strength at temperatures below 0°C and ages easily; if degassed in a vacuum, it retains a high impact strength even at -60° C. Experiments have shown that degassing unkilled steel

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in a vacuum can reduce within 5 to 7 minutes its initial 0.10 to 0.15% carbon content to 0.02%. Similar results are obtained by degassing in a vacuum electric alloy steels. Used on chrome-nickel steel, this process reduces drastically the number of fine cracks in it and eliminates its tendency to scaling. To prevent a secondary oxidation, the degassed metal should be poured in a protective atmosphere, without direct contact with ambient air. This is especially important in case of high-grade alloy steels. There are 8 diagrams, 1 graph and 1 photograph.

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18(5)

AUTHOR: Radźwicki, K.

TITLE: Increase in Steel Production by Heating of Deadhead (Zwiększenie uzysku stali przez nagrzewanie nadlewu wlewka)

PERIODICAL: Hutnik, 1958, Vol 25, Nr 11-12, pp 511-512 (Poland)

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Increase in Steel Production by Heating of Deadhead

of 1.0 to 1.2 kg per ton of steel, must not exceed 2 mm. The pressure of the oxygen must not be higher than 4 or 5 at; it is blown 2 to 3 minutes. The method of Khvorinov has been used at the "Serp i Molot" works on over 200,000 tons of steel already. The article is based on a report of N.P.Zhetvin, V.P.Tunkov and A.D.Zaytseva in "Stal'", 1957, Nr 7.

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POL/39-59-4-8/14

18(5,7)
AUTHOR: Radzwicki, K

TITLE: The Development of Vacuum Metallurgy and Casting in a Sheltered Atmosphere

PERIODICAL: Hutnik, 1959, Nr 4, pp 165-167 (Poland)

ABSTRACT: All metals in the liquid state tend to dissolve gases in varying degrees. This depends on such factors as the properties of the respective metals and gases, the pressures and temprerawures involved and the length of time during which metals and gases are in contact. It may generally be said that the hotter the metals, the more gas it will absorb. This of course has a detrimental influence on its properties as a metals in the solid state. Gases given off during cooling also effects the metals structure, causing blisters, pores, cavities etc. The need to do away with these flaws is all the greater in view of the ever-rising demand for high-quality metals. Vacuum processes have been developed in recent years above

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The Development of Vacuum Metallurgy and Casting in a Sheltered Atmosphere

all in the USA. Table 1 shows expansion in this field from 1957 to 1958. The table gives capacity figures for the three main vacuum processes: degasifying in vacuum chambers, melting and casting in a vacuum, using respectively induction and arc furnaces. Table 2 shows the degree of degasification achieved by these three methods for soft steel and stainless steel respectively. The cheapest of the three methods is the use of a vacuum chamber for degasifying. Even then costs are increased by about 8-9 dollars per ton. The induction furnaces system is the least economic, since the apparatus is expensive and its capacity is relatively small. One economic method is to cast in a sheltered atmosphere, in this case nitrogen which is fairly cheap and readily available. About 0.4 m^3 of this gas are required per ton. Though nitrogen casting is certainly no replacement for the vacuum processes, it at least eliminates surface flaws. There are 2

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POL/39-59-4-8/14

The Development of Vacuum Metallurgy and Casting in a Sheltered Atmosphere

tables and 7 references 2 of which are Soviet, 3 English, 1 German and 1 Polish

Card 3/3

RADZWICKI, K., doc.

Increase of steel yield from ingots. Hutnik P 28 no.9:347-349 S '61.

Influence of degasification of liquid steel in vacuum upon its hydrogen content. Ibid.:349-351

RADZWICKI, Kazimierz, doc.

Present state of using oxygen in open-hearth furnaces. Wiad hut 19 no.10:282-285 O '63

RADZWIECKI, K., doc.

Melting metals in electron stream. Hutnik P 29 no.11:432-438 N '62.

18(3,5,7) POL/39-59-7/8-2/24

AUTHOR: Radźwicki, Kazimierz, Docent, Master of Engineering

TITLE: The Influence of Vacuum Casting on the Structure and Forgeability of High Nickel Steel Ingots

PERIODICAL: Hutnik, 1959, Nr 7-8, pp 262-267 (POL)

ABSTRACT: High nickel steels are not well suited to modification processes. It may be said in general that the higher the nickel content, the worse the surface of billets after thermal modification or treatment, especially after rolling. There are several reasons for this. If high nickel steel contains sulphur to any significant degree, the nickel and sulphur tend to form a eutectic mixture with a low melting point which may in turn lead to brittleness at high temperatures. Fracturing or brittleness of high nickel steel ingots may be prevented by very careful heating before thermal treatment. A more harmful component of high nickel steel is hydrogen. Nickel even in the solid state tends to dissolve hydrogen rather easily. This often leads to internal blisters and cracks in ingots. The

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The Influence of Vacuum Casting on the Structure and Forgeability of High Nickel Steel Ingots

greatest care should therefore be taken in producing high nickel steel to take all measures designed to keep hydrogen content to a minimum. Another reason for flaws in high nickel steel ingots may be simply penetration of oxygen and sulphur from the air during casting. As a result of these considerations, the Ferrous Metallurgy Institute at Gliwice decided to experiment with vacuum casting of high nickel steel ingots. This was done using a basic arc furnace with a capacity of 250 kg, ingot moulds of 125 kg capacity and with an alloy containing about 0.08% carbon and about 36% nickel. Test forging was then carried out at exactly the same time and in exactly the same way as with steel ingots of the same composition cast under atmospheric pressure. The chemical composition of test ingots is given in table 1. Figures 1, 3, and 5 show the structure of ingots cast under atmospheric pressure, and figures 2 and 4, the cross sections of vacuum cast ingots. Table 2 gives the per-

centage forging yield from the first series of tests. Tables 3 and 4 give the same information as tables 1 and 2, but for the second series of tests. The author reaches the following conclusions from these experiments: it was found that vacuum casting completely eliminates the problem of swelling of ingots, even when their composition was least favorable, i.e. low carbon, manganese and silicon content. It was further found that vacuum casting radically reduces the extent of the zone of transcrystallization, thus improving the ingot's qualities. This is important, since extensive transcrystallization is one of the main reasons for poor forgeability of high nickel steel ingots. The tests confirmed that ingots with increased sulphur content, though not ideally suited for forging, can be successfully treated in this way if forging is carried out with care. Vacuum casting also tends to decrease the amount of cracks and blisters apparent in ingots cast under atmospheric pressure

The Influence of Vacuum Casting on the Structure and Forgeability of High Nickel Steel Ingots

and then forged in the normal manner. The author stresses in conclusion, that the experiments carried out as described above did not yield enough statistical data to arrive at any irrevocable conclusions. The conclusions drawn seem to indicate in a general manner, however, that vacuum casting does improve the forgeability of high nickel steel ingots. There are 4 tables, 5 photographs, and 6 references, 3 of which are German, 2 Polish, and 1 Czech.

ASSOCIATION: Instytut metalurgii żelaza, Gliwice (Institute of Ferrous Metallurgy, Gliwice)

POL/59-59-12-4/16

25(1)

AUTHOR: Radźwicki, Kazimierz, Docent, Master of Engineering

TITLE: Production of more Wear-Resistant and Durable Rails

PERIODICAL: Hutnik, 1959, Nr 12, pp 496-498 (Poland)

ABSTRACT: Steel rails produced in Poland today, containing up to 0.6% C and up to 0.9% Mn, are obsolete in view of higher load requirements and transportation running speeds. Research in the USA and the Soviet Union has indicated that it is advantageous to raise C content to 0.6-0.3% when Mn content is in the 0.6-1.0% range. Tests have shown that wearability can be reduced threefold by increasing the content of the D factor (% C + 0.25% Mn) from 0.73 to 0.99. Another way to increase durability is to adopt the heavier, Soviet-style profiles. Twofold to fourfold lifespan increases have been achieved in this way and this would justify the 30-50% weight increase involved. But both these solutions present difficulties since in both cases the tendency to steel flaking is significantly increased.

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Production of more Wear-Resistant and Durable Rails

To prevent this, two methods have been evolved abroad, namely isothermic annealing for 3 hours at 600°C in special furnaces immediately after rolling; and continuous slow cooling in air to 400°C and then in insulated and controlled surrounding to 150°C over a period of several hours. In order to improve rail quality, it has become a rule in the USSR to cast rail ingots exclusively in funnel-shaped, hot-top moulds. This solution, too, is impractical in Polish conditions in view of the physical state of most steel mills, lacking as they do sufficient space for the construction of improved rolling facilities and cooling pits. The author considers that an earnest attempt should be made to study the method of degassing liquid rail steel in vacuum chambers in view of its future large-scale application. Experiments with this method have given good results and the Soviet scientist Samarin has noted twofold decreases in H content, up to eightfold decreases in O content and up to 20% decreases in

Production of more Wear-Resistant and Durable Rails

N content. This method of degassing has also led to improvements in the mechanical properties of steel. Experiments were carried out with a 16-ton ladle in a vacuum chamber, degassing time being 12-14 minutes and pressure 70-100 mm Hg. In the author's opinion, an installation of this kind would cost 0.5-1 million zloty and this would certainly be cheaper than the construction of cooling pits. There are 3 references, 2 of which are Soviet and 1 English.

ASSOCIATION: Instytut Metalurgii Zelaza (Institute of Iron Metallurgy, Gliwice).

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RADZWICKI, Kazimierz, doc.

High pressure smelting of alloy steel containing nitrogen.
Wiad hut 15 [i.e. 20] no.5:134-135 My '64.

25(1) POL/39-59-12-4/16

AUTHOR: Radźwicki, Kazimierz, Docent, Master of Engineering

TITLE: Production of more Wear-Resistant and Durable Rails

PERIODICAL: Hutnik, 1959, Nr 12, pp 496-498 (Poland)

ABSTRACT: Steel rails produced in Poland today, containing up to 0.6% C and up to 0.9% Mn, are obsolete in view of higher load requirements and transportation running speeds. Research in the USA and the Soviet Union has indicated that it is advantageous to raise C content to 0.6-0.8% when Mn content is in the 0.6-1.0% range. Tests have shown that wearability can be reduced threefold by increasing the content of the E factor (% C + 0.25% Mn) from 0.73 to 0.99. Another way to increase durability is to adopt the heavier, Soviet-style profiles. Twofold to fourfold lifespan increases have been achieved in this way and this would justify the 30-50% weight increase involved. But both these solutions present difficulties since in both cases the tendency to steel flaking is significantly increased.

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Production of more Wear-Resistant and Durable Rails

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Production of more Wear-Resistant and Durable Rails

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ASSOCIATION: Instytut Metalurgii Zelaza (Institute of Iron Metallurgy, Gliwice).

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18(5,7) POL/39-59-11-3/16

AUTHOR: Radzwicki, Kazimierz, Docent, Master of Engineering

TITLE: Refractory Materials in View of Technical Progress in Steel Metallurgy

PERIODICAL: Hutnik, 1959, Nr 11, pp 441-443 (POL)

ABSTRACT: The author describes the progress in steel making techniques after WW II, when it was found out that high grade steel can be produced in Bessemer converters when oxygen is used in the process. Oxygen reduces the phophorus content in steel. A finishing oxygen and water vapor blast in converters keeps the nitrogen content within 0.002-0.004% which is considerably less than the nitrogen content in open hearth steel (0.004-0.007%). The author further states that the use of oxygen in open hearth and electric arc furnaces also improves the quality of steel and production efficiency. However, the use of oxygen in the steel making process causes a considerable rise in temperature which in turn calls for better refractory materials. Further, the problem of finding proper refractory materials for open hearth furnaces (silicate bricks, basic chrome-magnesite materials

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Refractory Materials in View of Technical Progress in Steel Metallurgy

of improved quality), electric furnaces (improved silicate materials and special lining materials, prefabricated lining for repair) and for casting ladles is presented. Oxygen converters will be built in two Polish steel plants in near future, and a 5-ton experimental converter will most probably be in operation in 1960. An experimental 10-ton turbo open hearth converter (with a side blast of pressurized air) is in operation at the "Bobrek" Steel Plant. The Instytut materialow ogniotrwalych (Institute of Refractory Materials) has to design durable blast nozzles for turbo open hearth converters. It is suggested that production of mono-block nozzle units should be started instead of sub-assembled nozzles. A four-line continous steel casting installation is scheduled to be operative in Poland in 1961 and produce blooms for tube production. An experimental continous casting installation for high grade steel will probably be in operation in 1960. Proper lining for the casting ladles will have to be developed by the

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Refractory Materials in View of Technical Progress in Steel Metallurgy

Instytut metalurgii zelaza (Institute of Iron Metallurgy) in cooperation with the Institute of Refractory Materials. At the close, the author points out that degasing liquid steel in a vacuum also requires proper refractory materials which must have good thermal isolation qualities along with low porosity. Conjunction of these two qualities constitutes a problem.

ASSOCIATION: Instytut metalurgii zelaza (Institute of Iron Metallurgy) Gliwice.

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RA.ZWICKI, K.; MATKANIEC, J.

Oxygen converter process; the Lonz and Donawitz process. p. 28.

(PUTNIK, Vol. 74, No. 1, Jan. 1957, Katowice, Poland.)

SO: Monthly List of East European Accessions (EEAL) LC. Vol. 6, No. 10, October 1957. Uncl.

RADZWICKI, K; BRATKOWSKI, S.

Technology of founding half-quenched steel containing less carbon than 0.30 0/0.

Biuletyn. p. 37.

HUTNIK, Vol. 22, No. 10 October, 1955

(Panstwowe Wydawnictwa Techniczne) Katowice

SOURCE: EAST EUROPEAN ACCESSIONS LIST Vol. 5, No. 1 Jan. 1956

RADZ : CKI, K.

Origin of nonmetallic elements in steel for journal bearings. p. 377.

HUTNIK, Vol. 22, No. 10 October, 1955

(Panstwowe Wydawnictwa Techniczne) Katowice

SOURCE: EAST EUROPEAN ACCESSIONS LIST Vol. 5, No. 1 Jan. 1956

RADZIKI, KAZIMIERZ, ed.

Kontrola jakości produkcji w hutnictwie żelaza; praca zbiorowa. (Wyd. 1.) Stalinogród, Wydawn. Górniczo-Hutnicze, 1955. 481 p. (Control of the quality of production in iron metallurgy; a collective work. 1st ed. illus., bibl., diagrs., footnotes, graphs)

So: Eastern European Accession. Vol 5, no. 4, April 1956

RADZ:ICKI, K.

Time studies on units of work in a blast-furnace foundry.

p. 114
Vol. 21, no. 4, Apr. 1954
HUTNIK
Katowice

SO: Monthly List of East European Accessions (EEAL), LC, Vol. 5, no. 2
Feb. 1956

Radzwicki, K.

Influence of carbon monoxide blasted in electric-arc furnaces on the quality of steel p. 177, Vol. 22, no. 5, May 1955, HUTNIK

SO: MONTHLY LIST OF EAST EUROPEAN ACCESSIONS, (EEAL), Vol. 4, LC, No.9, Sept. 1955, Uncl.

Radzwicki, K.

Intensifying steel founding processes. p164, Vol. 22, no. 5, May 1955, HUTNIK

SO: MONTHLY LIST OF EAST EUROPEAN ACCESSIONS, (EEAL), Vol. 4, LC, No.9, Sept. 1955, Uncl.

RADZIWICKI, K.

Intensification of Steelmaking Processes. K. Radziwicki. (*Hutnik*, 1955, 22, (5), 164–171). [In Polish]. The use of oxygen for the intensification of the O.H. process is outlined. The use of the air-blown convertor and L.D. process for steelmaking is described.—v. o.

RADZWICKI, K. & BRATKOWSKI, S.:

Technology of the production of semi-killed steel of a carbon content below 0.30%.
By K. Radziwicki and S. Bratkowski ...

SO: Hutnik, #10, Oct 55, pp 37-39 Appendix.

RADZWICKI, K.:

The origin of non-metallic intrusions in steel for machined bearings. (from Izv.Ak.Nauk, Otd.Tekhn.Nauk, 1955, No. 3, pp. 91-101).
By K. Radzwicki ...

SO: Hutnik, #10, Oct 55, pp349-392, & Appen.

RADZWICKI, K.

Inst. (3)

Fuel Abst.
Vol. 15
Jan. 1954
Industrial Furnaces, Kilns, etc; Combustion

690. DIFFUSION DEOXIDATION WITH COKE IN BASIC OPEN HEARTH FURNACE. Radzwicki, K. and Kozielski, J. (Prace GIMO (Contr. Chief Inst. Metallurg. Found.), 1951, 267-277; abstr. in Chem. Abstr., 1953, vol. 47, 7391).
The application of diffusion deoxidation with coke in basic open hearth furnaces lead the authors to the following conclusions: (1) This method is more efficient than is the sedimentation method; (2) coke addition does not result in introduction of additional phosphorus or carbon, (3) steel output is greater and cost of cleaning of semi-finished product is lower; (4) duration of the whole process remains unaffected; (5) the method gives great savings in deoxidizers and ferro-alloys. C.A.

RADZ?ICKI, K.

(EUTNIK, Vol. 20, No. 11, Nov. 1953, Katowice, Poland)
"How steel should be poured into molds; from the top or from the bottom?" p. 349

SO: MONTHLY LIST OF EAST EUROPEAN ACCESSIONS, L.C., Vol. 3, No. 4, APRIL 1954

RADZWICKI, K.

Chemical Abst.
Vol. 48 No. 8
Apr. 25, 1954
Metallurgy and Metallography

Reclaiming of high-speed steel by remelting scrap in an arc furnace. K. Radzwicki. *Prace Inst. Mistrzerstwa Hutnic* 5, 113–18 (1953).—Investigation showed that the most economical method of reclaiming valuable addns. contained in high-speed steel scrap is to use a charge consisting of 100 units of scrap and 5 units of mill scale from high-speed steel.
M. O. Holowaty

RADZIWIŁŁOWICZ, K.

"Choosing the Most Proper Method of Deoxidizing High-speed Cutting Steel in an Electric Arc Furnace." Biuletyn Informacyjny. p. 25 (HUTNIK, Vol. 20, No. 7, July 1953) Warszawa

SO: Monthly List of East European Accessions, Library of Congress, Vol. 2, No. 10 October 1953. Unclassified.

RADZWICKI , K.

"Increasing the Efficiency of Open-Hearth Furnaces" p. 4 (Wiadomosci Hutnicze, Vol. 9, No. 4, Apr., 1953, Stalinogrod)

SO: Monthly List of East European Accessions, Vol. 3, No. 2, Library of Congress, February, 1954, Uncl.

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The Choice of Deoxidation Method for High-Speed Steels in a Basic Electric Arc Furnace. K. Radzwicki. (*Biuletyn Informacyjny Instytutow Ministerstwa Hutnictwa*, 1953, 4, (7), 25–28 ; *Hutnik*, 1953, 20, (7)). [In Polish]. Three methods of deoxidizing high-speed steel were tested : (1) Deoxidation under a white slag by adding electrode carbon powder ; (2) deoxidation under a carbide slag ; and (3) two-stage deoxidation under a white slag first with carbon powder and then with powdered ferrosilicon. The structure, quantity of non-metallic inclusions, and cutting properties of steels produced by these methods were examined. The steel produced by all three methods was of equal quality, but for economic and technical reasons the third method is most suitable because the finishing stage is shorter and the electricity consumption is smaller.—v. g.

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RADZWICHI, K.

Fuel Abst.
Vol. 15
Jan. 1954
Industrial Furnaces, Kilns, etc; Combustion

690. DIFFUSION DEOXIDATION WITH COKE IN BASIC OPEN HEARTH FURNACE. Radzwicki, K. and Kozielski, J. (Prace GIMO (Contr. Chief Inst. Metallurg. Found.), 1951, 267-277; abstr. in Chem. Abstr., 1953, vol. 47, 7391). The application of diffusion deoxidation with coke in basic open hearth furnaces lead the authors to the following conclusions: (1) This method is more efficient than is the sedimentation method; (2) coke addition does not result in introduction of additional phosphorus or carbon, (3) steel output is greater and cost of cleaning of semi-finished product is lower; (4) duration of the whole process remains unaffected; (5) the method gives great savings in deoxidizers and ferro-alloys. C.A.

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(2)

BTR, v. 3,
Feb 1954
Metallurgy

✓2242* Reclaiming Melts of High-Speed Steel Waste in an Electric Arc Furnace. (Polish.) K. Radzwicki. *Prace Instytutow Ministerstwa Hutnictwa*, v. 5, no. 3, 1953, p. 113-118.

Discusses reclaiming melting entirely without oxidizing and with partial oxidizing. Describes advantages of adding high-speed steel cinder to the charge. Tables. 7 ref.

RADZWICKI, K.

Utilization of coke in the basic open-hearth furnace / K. Radzwicki and J. Kozielski (Hutnik, Warsaw, 1951, 5, 267-271).

Addition to coke to the slag layer does not lead to increased C or P contents of the steel, or to formation of nonmetallic inclusions, whilst at the same time the Fe content of the slag falls, and the consumption of Mn is halved. The process is more economical in labour and materials that is the electric-hearth one, whilst the quality of the products is the same. R. Truscoe.

RADZWICKI, K.

(Polish) K. Radzwicki, J. [illegible], and W. [illegible]: "[illegible] Ore Fines for Steel Plants." (Prace Glownego Instytutu Metalurgii, 19[illegible], No. 3, pp. [illegible].)

Immediate source clipping

RADZWICKI, K.

Over

Briquetting of Ores Fines for Steel Plants. AK. Radzwicki, W. Madej, and W. Stronczak. (*Prace Glownego Inst. Met.*, 1951, No. 3, 173–181). [In Polish]. Very good results were obtained in briquetting ore concentrates by Jarcho's method (used in U.S.S.R.) in which fines are mixed with small amounts of iron filings, water, and sodium chloride (0·5–1%). The method is based on corrosion processes which bind ore particles together. The highest strength of briquettes and the shortest time of hardening are obtained when the components are mixed so as to obtain the highest temperature increase during the corrosion process. Best results are obtained if the mix is pressed when at its highest temperature. However, sodium chloride is objectionable due to the destructive influence of alkali on refractory linings. Experiments were therefore made in which CaO, HCl, $MgCl_2$, H_2SO_4, ferrous sulphate, and spent pickling liquor were used as substitutes for sodium chloride. Investigations were made with ore concentrates containing Fe 71·2%, SiO_2 1·57%, CaO 2·29%, MgO 0·43%, P 0·13%, and S 0·039%. In laboratory experiments cylindrical briquettes (dia. and height about 50 mm., weight about 400 g.) were made at a pressure of 250 kg./sq. cm. Industrial briquettes (250 × 130 × 65 mm. weighing 6–7 kg.) were made on a brick-making machine at the same pressure. Fresh briquettes were left in the air under cover, and samples were tested every day for strength to follow the process of hardening. Minimum requirements for a briquette were taken from Russian practice, namely: (1) Compression strength min. 50 kg./sq. cm.; (2) shatter test: a briquette dropped twice on a steel plate from a height of 2 m. must not produce more than 10% fines (below 5 mm.); (3) porosity not more than 5–10%; (4) briquettes must not crumble when

RADZWICKI, Kazimierz, doc.

Smelting of stainless chromium-nickel steel containing 0.03% C. Wiad hut 19 no. 6: 149-151 Je '63.

RADZWICKI, Kazimierz, doc. mgr inz.

Desulfurization of pig iron independently of blast furnaces. Wiad hut 15 [i.e. 20] no. 2: 39-41 F '64.

P/043/60/000/011/002/002
A223/A026

AUTHOR: Radźwicki, Kazimierz, Docent, Master of Engineering

TITLE: Vacuum Degassing of Liquid Steel and the Selection of the Most Suitable Degassing Method

PERIODICAL: Wiadomości Hutnicze, 1960, No. 11, pp. 342 - 345

TEXT: The ever-increasing demand for steel of higher purity and better mechanical properties calls for effective methods, which will reduce gas and impurities content of steel. During the last few years the vacuum degassing method has been widely used. There are three basic vacuum degassing method in use today, i. e. 1) degassing in the casting ladle, in three versions: a) by the fraction-method; b) by the circulation method and c) by the vacuum-chamber method; 2) degassing during the pouring of steel from the ladle at workroom temperature to another ladle placed in a vacuum and 3) degassing during the pouring of steel from the ladle at workroom temperature into the mold placed in a vacuum. The degassing by the fraction-method is presented in Figure 1. This method reduces the oxygen content by 50 - 60%, the hydrogen content by 40% and the nitrogen content by 15 - 20%. The main advantage of this method is that the metal can be degassed before the deoxidizing process and the deoxidizing process is applied in the final degassing phase. This makes

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Vacuum Degassing of Liquid Steel and the Selection of the Most Suitable Degassing Method

for a small amount of deoxidizing agents and a small amount of resulting deoxidizing products. However, the method has considerable draw-backs, i.e. 1) the high cost of heating the vacuum chamber before and during the degassing process; 2) since the already-degassed steel drops to the bottom of the ladle by passing through steel not yet degassed there is a danger of the degassed steel becoming re-gassed and 3) steel degassed by this method is cast into mold at workroom temperature which makes for re-gassing of degassed steel. The degassing method by circulation is shown in Figure 3. The results as well as the advantages and disadvantages of the version are similar to those of the fraction-method. The degassing in vacuum chamber is shown in Figure 4. This is the cheapest and the simplest degassing method and also the most suitable one for such products as rails with over 75 kg/mm^2 cold-rolled strip etc. Up to recently the degassing of steel in vacuum widely practised in the West raised doubts concerning its effectiveness. These doubts were justifiably caused by the low-productivity vacuum pumps which have a working pressure rarely below 35 Tr during the degassing process. At present with the pressure in the vacuum chamber being decreased by several Tr, as shown by German research, this method is becoming not only the most effective one but also the one making for a complete uniformity

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Vacuum Degassing of Liquid Steel and the Selection of the Most Suitable Degassing Method

of degassing in metal. The method of degassing steel during the pouring from the ladle at workroom temperature into a ladle placed in a vacuum is shown in Figure 5 and is based on stream degassing. The oxygen content is reduced by this process by 80%, the hydrogen content by 50 - 60% and the nitrogen content by about 30%. The disadvantages of this method are 1) loss of heat during the transfer of steel from one ladle to the other and 2) danger of regassing of steel during the casting into molds. The author maintains, however, that this method is suitable for transformer steels since the silicon iron added to the steel in vacuum compensates for the heat losses in the second ladle. The method of degassing steel during the casting into molds placed in vacuum is shown in Figures 6 and 7. This method is suitable for steels which have already been subjected to all other necessary processes. The low hydrogen content of this steel makes it suitable for heavy forgings which otherwise show a tendency to flaking. The tendency is not fully eliminated by this process since, according to the experience of American steel plants, only a decrease in the hydrogen content up to 1.5 $cm^3/100$ g allows a shorter heat treatment of forgings. Therefore, if the hydrogen content can be decreased to a minimum of 80% in relation to the original content before degassing, the original hydrogen content of steel must not be higher than 7 cm^3 per 100 g. There are 7 figures and 6 references.

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A223/A026

Vacuum Degassing of Liquid Steel and the Selection of the Most Suitable Degassing Method

3 German, 2 English and 1 Soviet.

Card 4/4

RADZWICKI, Kazimierz, doc. mgr inz.

Possibility, from the practical point of view, of competition between a steel works equipped with open-hearth furnaces and a steel works operating by the oxygen converter gas method? Wiad hut 15 no.11:339-340 N '64.

RADZWICKI, R.

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13449 Degassing of Steel in Vacuum. H. Zakrzwa and R. Radzwicki. *Henry Brutcher Translation No.* 3921, 9 p. (From *Biuletyn Informacyjny, Hutnik, Poland*), v. 7, no. 11, 1956, p. 41-45.) Henry Brutcher, Altadena, Calif.

Polish work on the extent to which molten steel can be degassed by various methods.

SZARGUT, Jan; RADZYMINSKI, Aleksander

Power balance of an ironworks. Problem proj hut maszyn 10 no.7:193-199 Jl '62.

1. Politechnika Slaska, Gliwice.

1. MAZURINS'kyi, K. N.

2. USSR (600)

4. Influenza

7. Accessory sinuses of the nose in grippe, Mecych. zhur., 27, no. 1, 1952.

9. Monthly List of Russian Accessions, Library of Congress, April 1953, Uncl.

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Flameless gas radiator. Gosp paliw 11 Special issue no. (95):14-15 Ja '63.

1. Huta im. Lenina, Krakow (for Radzyminski). 2. Centralne Laboratorium Gazownictwa, Krakow (for Pawlikowski).

KANEVSKAYA, S.M.; RADZYUKEVICH, T.M.; KITAYEVA, L.N.; SOKOLOVA, N.N.

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LUKYANOV, Valeriy Vyacheslavovich; RALEYUKEVICH, Ye.I., red.

[Fundamentals of the theory and practice of gas burning in steam boilers] Osnovy teorii i praktiki szhiganiia gaza v parovykh kotlakh. Moskva, Energiia, 1964. 318 p. (MIRA 17:10)

ZHIRNOV, Nikolay Ivanovich; KROL', Lazar' Borisovich; LIVSHITS, Emmanuil Moiseyevich; RABKIN, Yuriy Isaakovich; RADZYUKEVICH, Ye.I., red.; BORUNOV, N.I., tekhn. red.

[Large peak load water-heating boilers] Pikovye vodogreinye kotly bol'shoi moshchnosti. Moskva, Izd-vo "Energiia," 1964. 167 p. (MIRA 17:4)

BANNIK, Viktor Petrovich; SLUCHAYEV, Mikhail Aleksandrovich [deceased]; RADZYUKEVICH, Ye.I., red.; BORUNOV, N.I., tekhn.red.

[Installation of steam turbines] Montazh parovykh turbin. Izd. 3., perer. Moskva, Gos.energ.izd-vo, 1959. 319 p. (MIRA 12:4)
(Steam turbines)

MEYKLYAR, M.V.; RADZYUKEVICH, Ye.I., red.; BORUNOV, N.I., tekhn.red.

[Steam boilers with natural circulation] Parovye kotly s estestvennoi tsirkuliatsiei. Izd.2., perer. Moskva, Gos. energ. izd-vo, 1958. 287 p. (MIRA 12:1)
(Boilers)

RADZWICKI, K., doc.

Development of continuous steel casting based on data for the years 1960 and 1961. [illegible] '62.

RADZWICKI, K., doc.

Technical progress in the electric process based on data taken from writings published during the years 1960 and 1961. Hutnik P 29 no.7/8:293-295 Jl-Ag '62.

RADZWICKI, K., doc.

Development of the steel industries (Martin and electrical processes) in the light of the technological literature for the years 1959 - 1960. Hutnik P 28 no.7/8:295-298 Jl-Ag '61.

RADZWICKI, Kazimierz, doc. mgr inz.

Development of electric slag steel remelting and the quality of obtained ingots and semifinished products. Wiad hut 19 no.3:66-70 Mr '63.

RADZWICKI, Kazimierz, doc. mgr inz.

Possibilities and ways of Polish production of railway rails of higher strength and durability. Wiad hut 18 no.11:339-342 N '62.

P/043/62/000/002/001/001
D001/D101

AUTHOR: Radźwicki, Kazimierz, Docent, Master of Engineering

TITLE: Acceleration of metallurgical reactions in steel bath by injection of pulverized substances or mixing with slag

PERIODICAL: Wiadomości hutnicze, no. 2, 1962, 40-42

TEXT: The article is a brief, selective review of novel principles in steel refining, all of which effect an increase in the contact area between molten steel and slag or other reagents. Some of the methods are frequent vigorous stirring, simultaneous tapping of steel and slag, or discharge of steel into ladles already charged with liquid synthetic slag. Another recently developed method employs a jet of inert or active gas to force into the metal bath pulverized substances such as chalk, slag or carbon. The different reactions that take place depend on the type of powder used and are characterized as follows: 1) The powder does not melt or dissolve in the metal bath; the reaction product is of solid stuff. The method is applied for desulfurization by means of finely pulverized chalk, sometimes with an addition of reducing metals like aluminum or magnesium. 2) An active substance like pulverized slag, usually injected in slight excess, melts in the metal

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Acceleration of metallurgical ....

bath and the reaction products dissolve in droplets of molten slag. 3) Injection of pulverized reducing substances of alloying or carburizing materials into the metal bath by means of an inert gas blast. The technique is far more effective than conventional procedures. 4) Both the pulverized substance and carrier gas can participate in the reaction; the product is in a liquid state. The reaction activity can be controlled by gas-powder ratio. A good example can be observed in refining pig iron by injection of pulverized chalk or ore in an oxygen blast; oxidized silicon and phosphorus form stable compounds with chalk. In addition, undesired impurities like C, Si, Mn, and P are bonded by excess oxygen. Pulverized carbon makes for a fast carburization of steel. The Soviet scientist Z. M. Kudryavtsev [Ref. 5: Stal, vol. 21, no. 5, 1961. 464-467] tells how to calculate and design a nozzle for injection of pulverized substances into the metal bath. There are 2 Soviet-bloc and 3 non-Soviet-bloc references.

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RADZWICKI, Kazimierz, doc. mgr inz.

Decline of the open-hearth process? Wiad hut 16 no.1:15-17 Ja '60.

1. Instytut Metalurgii Zelaza, Gliwice.

RADZWICKI, Kazimierz, doc. mgr inz.

Degassing of liquid steel and selection of the most appropriate way of doing it. Wiad hut 16 no.11:342-345 N '60.

P/039/61/000/005/001/001
D001/D101

AUTHOR: Radźwicki, Kazimierz, Docent

TITLE: Attempts of electro-slag steel melting on a laboratory scale

PERIODICAL: Hutnik, no. 5, 1961, 192-196

TEXT: The article describes experimental steel scrap melting at the laboratory of the Instytut Metalurgii Żelaza (Institute of Iron Metallurgy) in Gliwice. The purpose of this work was to examine melting conditions while using different kinds of start-up and reducing slags. The method of electro-slag melting was originally worked out at the Institut Elektrosvarki im. Ye. O. Patona (Institute of Electric Welding im. Ye. O. Paton) in Kiev. The method is used on an industrial scale at the Dneprospetsstal metallurgical plant in a one-phase electric arc furnace with a consumable electrode made of scrap steel. Drops of melt are purified while passing through a layer of molten and highly superheated synthetic slag. During this passage about 50% of sonims and 50% of the sulfur content in steel are

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Attempts of electro-slag...

removed. Steel ingots thus obtained have a fine structure and improved forging properties. Forged, rolled or cast rods, or siphon cores can be used as consumable electrodes in this process. It takes 1 hour to produce a 200 kg ingot; electrode consumption is given as 1.06-1.20 tons per ton of ingot. The method is costly (about 1,300 rubles per ton) and is applied only for making special, very high grade steel. This process was repeated on a laboratory scale at the Institute of Iron Metallurgy in order to test various sorts of synthetic slags. The installation was designed by the Institute's staff and consisted of a copper crystallizer 120 m high [Abstracter's note: This is an obvious misprint and should read 120 mm] and 50 mm in diameter; the consumable electrode had a diameter of 18-25 mm. The installation was put into operation in March 1960. Following synthetic slags were tried out: the start-up slag with good conductivity to set off the electric arc and a composition of 65% TiO_2, 30% Al_2O_3 and 5% CaO. Fine steel filings were added to this mixture at the ratio of 40%:60% by weight, eventually altered to 50%:50%. The four versions of reducing slag consisted of: a) 65% CaF_2, 30% Al_2O_3,

Attempts of electro-slag...

5% CaO; b) 70% CaF_2, 30% Al_2O_3; c) 70% Al_2O_3, 30% CaF_2; d) 80% CaF_2, 20% Al_2O_3. The consumable electrode was made of ŁH15 bearing steel scrap. The experiment was performed 10 times using alternately all four reducing slags. The best results were achieved with the slag under d) above which gave a uniformly smooth ingot. The composition of reducing slag is decisive for ingot shape and quality. The consumable electrode consisted of 1.08% C, 0.36% Mn, 0.26% Si, 0.017% P, 0.016% S and 1.06% Cr. Average sonim contamination of the electrode approached the Diergarten scale standard No. 1.07.02. Ingots obtained with reducing slag under d) above contained 0.98-0.99% C, 0.30% Mn, 0.24-0.25% Si, 0.018-0.019% P, 0.011% S and 1.05% Cr. Their sonim contamination approached Diergarten scale standard No. 1.07.01. Results of these experiments call for confirmation on an industrial scale. Master Engineer H. Żakowa and Master Engineer J. Rytych, both of the IMŻ, are mentioned for their cooperation in this study. There are 4 photos and 3 Soviet references.

ASSOCIATION: IMŻ (Institute of Iron Metallurgy), Gliwice.

P/039/60/000/009/006/010
A221/A026

AUTHORS: Radźwicki, K., Docent; Grobicki, W., Docent; - Masters of Engineering

TITLE: Novelties From the Field of Metallurgy. Steel Industry. The Progress of Vacuum Metallurgy in World Iron Metallurgy on the Basis of 1959 Literature

PERIODICAL: Hutnik, 1960, No. 9, pp. 348 - 354

TEXT: This article is divided into two parts, with sub-titles: a) degassing of liquid steel in vacuum, b) melting and pouring of steel in vacuum. The author selected 34 of the most important works from the 1959 world literature dealing with problems of steel degassing and presents a short résumé of each. Sokolov and Oyks (Ref. 1) produced an indicating method, allowing for a quantitative valuation of liquid steel degassing procedure. By applying this method, they found that 80% of gas escapes during the first 3 - 4 min from the ladle after it was placed in a vacuum chamber. Liquid steel convection movements in the ladle contribute to mixing and better degassing. Samarin and Novik (Ref. 2) compare Bessemer and openhearth steel properties. The former is of

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inferior quality because of P, S, N and O content. By degassing Bessemer steel in vacuum, 77.5% of oxygen, 52.3% of hydrogen, but only 10 - 15% of nitrogen escape. The quality of steel has improved, especially its shock resistance at low temperatures. Antropov and Guryevich (Ref. 8) investigated the influence of degassing on electrical steel properties. EI 72 steel tends to form much less of internal capillary cracks after degassing and, therefore, the amount of scrap dropped by 50%. After degassing it contained 30 - 50% less hydrogen and 20 - 30% less oxygen. Degassing of steel during the crystallization period in the mold deteriorates its structure and contributes to shrinkage cavities formation. K. Radźwicki (Ref. 21) presented the results of investigations carried out at the Instytut Metalurgii Żelaza (Iron Metallurgy Institute) in Gliwice, on forging properties of steel with high nickel content. Ingots from degassed steel showed better forging properties and less transcrystallization. These experiments will be repeated on industrial scale. Pryanishnikov (Ref. 23) discusses the trial smelting of transformer steel in vacuum-induction furnace of 150 kg capacity. It was found that transformer-steel quality is better if the

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charge melts in atmospheric conditions and only working and deoxidation of same takes place in vacuum. Pouring of this steel should be carried out rather in a protective atmosphere and not in a vacuum; on the other hand, addition of FeSi should be done in vacuum and after addition the melt should be kept under vacuum for about 10 min. Pressure forming and magnetic properties of steel prepared in vacuum were better than in conventional steel. Shabanov (Ref. 24) explains some problems connected with steel smelting in arc ovens with a melting electrode, and he produces a formula for the calculation of the ratio between electrode and crystallizer diameters. He also found that a) current density should be adjusted with reference to the electrode diameter, b) metal losses diminish with increased electrode diameter, c) the content of alloy components may vary within a wide range, d) content of oxygen in steel molten at a pressure of 1 Tr or less, drops 2.5 times or more. Byelanchkov and Gryigorash (Ref. 32) examined the influence of various technological factors on degassing of steel melted in vacuum-arc-ovens in crucibles of 2 and 7 kg capacity. Increased melting speed acts adversely on hydrogen and advantageously on oxygen and nitrogen escape.

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The optimum ratio of electrode-to-crucible diameter was established to be: D ÷ d = 0.77. An article under the title "Rolling Ways for Extension of Service Life of Heavy Type RR Rails in USSR", written by Doctor of Engineering Danilov, appeared in an official organ of the USSR Ministry of Transportation "Zheleznodorozhnyy Transport" 1960, No. 3. The author states that heavy RR rails R50 and R65, used on heavy traffic lines, proved not to be strong enough, especially on the inner arcs. Rails which should withstand 500 million tons load gross have shown faults already after being exposed to 50 - 60 million tons gross, marked in an official faults register as No. 64 and 82, i.e., metal overflow, wear and small cracks of fatigue type. The author thinks that a radical way to improve the matter is to use a better quality steel for RR rails. For the time being, however, the author suggests a series of temporary measures. 1) To increase the cross slope of rails on the outer bend from 1 : 20 to 1 : 10. This can be done by inserting between the sole-plate and the tie a wedge shaped pad. This might reduce the wearing out of rail heads by 20 - 30%; 2) to relinquish the hitherto applied 1 : 40 cross slope of heavy rails R65 and R75; 3) to clean the rail an-

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nually and remove metal flow, flakings, etc.; 4) to regenerate rails removed from main RR tracks; 5) to maintain RR tracks. It might be advantageous to reduce the track gauge from 1,524 mm to 1,518 mm; 6) to improve the defectoscopic method of rail examination in situ; ultrasonic defectoscopes as used in metallurgical plants for sheet thickness control can be applied; 7) to reduce the dynamic action of wheels against rails. Investigations in the direction of improving steel quality are going on for several years, but without any positive results. They are: a) hardening the whole length of rails, particularly those for bends, b) investigations on improving steel quality by addition of some imported noble additives, e.g., manganese in relatively large proportions of 12 - 14%. This is an expensive way, but in the long run it might be justified to do it. There are 34 references: 6 Soviet, 1 French, 11 German, 14 English and 2 Polish.

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POL/39-59-7/8-11/24

18(5)
AUTHOR: Radźwicki, K.

TITLE: Comparison of the Technical and Eccnomic Indexes of Arc and Open-Hearth Furnaces

PERIODICAL: Hutnik, 1959, Nr 7-8, pp 315-316 (POL)

ABSTRACT: As the capacity of electric furnaces increases so the cost of producing steel in this manner decreases. Technical literature shows that in the largest electric furnaces (over 100 tons capacity) 520-560 kWh is used up per ton of common carbon steels and 560-580 kWh per ton of steel alloys where oxygen is used in the process. In small furnaces, this cost may reach 700 kWh/t or even more. With the rapid development of electric processes in steel making in recent years, comparative figures are now available. From these it is evident that open-hearth furnaces are cheaper to operate almost in every case, since the cost of their fuel is always smaller than the electric power and electrodes used in electric furnaces. Where the open-hearth furnaces operate on a liquid charge

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Comparison of the Technical and Economic Indexes of Arc and Open-Hearth Furnaces

and the arc furnaces on a solid charge, the difference in costs is fourfold in favor of the open-hearth furnace. This is so despite the fact that the coefficient of heat utilization is 2.5 times smaller for open-hearth furnaces than for electric furnaces. The explanation lies mainly in the fact that electric power is much more expensive than the fuel oil used to fire open-hearth furnaces. On the other hand, it has been found that as the capacity of furnaces increases, this difference tends to disappear. Also an argument in favor of electric furnaces is the fact that the building cost of such a furnace is about 40% lower than the cost of building an open-hearth furnace. Moreover, the quality of ingots obtained from an arc furnace is usually better than from an open-hearth furnace. Again, open-hearth furnaces require lengthier maintenance, firing and banking procedures, electric furnaces being more efficient from the point of view of time-consumption. On the basis of observations made

Comparison of the Technical and Economic Indexes of Arc and Open-Hearth Furnaces

in the USA in recent years, the author reaches the conclusion, that given large-capacity furnaces, costs of steel production for both types discussed above are almost even and in some cases the same, especially when the furnaces operate exclusively on a solid charge.

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18(5,7) POL/39-59-4-8/14

AUTHOR: Radzwicki, K

TITLE: The Development of Vacuum Metallurgy and Casting in a Sheltered Atmosphere

PERIODICAL: Hutnik, 1959, Nr 4, pp 165-167 (Poland)

ABSTRACT: All metals in the liquid state tend to dissolve gases in varying degrees. This depends on such factors as the properties of the respective metals and gases, the pressures and tempreratures involved and the length of time during which metals and gases are in contact. It may generally be said that the hotter the metals, the more gas it will absorb. This of course has a detrimental influence on its properties as a metals in the solid state. Gases given off during cooling also effects the metals structure, causing blisters, pores, cavities etc. The need to do away with these flaws is all the greater in view of the ever-rising demand for high-quality metals. Vacuum processes have been developed in recent years above

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The Development of Vacuum Metallurgy and Casting in a Sheltered Atmosphere

all in the USA. Table 1 shows expansion in this field from 1957 to 1958. The table gives capacity figures for the three main vacuum processes: degasifying in vacuum chambers, melting and casting in a vacuum, using respectively induction and arc furnaces. Table 2 shows the degree of degasification achieved by these three methods for soft steel and stainless steel respectively. The cheapest of the three methods is the use of a vacuum chamber for degasifying. Even then costs are increased by about 8-9 dollars per ton. The induction furnaces system is the least economic, since the apparatus is expensive and its capacity is relatively small. One economic method is to cast in a sheltered atmosphere, in this case nitrogen which is fairly cheap and readily available. About 0.4 m^3 of this gas are required per ton. Though nitrogen casting is certainly no replacement for the vacuum processes, it at least eliminates surface flaws. There are 2

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tables and 7 references 2 of which are Soviet, 3 English, 1 German and 1 Polish

18(5) POL/39-59-7/8-10/24

AUTHOR: Radźwicki, K.

TITLE: The Life Span of Steel Ingot Moulds

PERIODICAL: Hutnik, 1959, Nr 7-8, pp 314-315 (POL)

ABSTRACT: This is an important problem not only from the economical point of view but also because the expansion of Poland's steel industry requires also the expansion of foundries making ingot moulds. The author notes that ingot moulds in Poland are often produced by foundries which have no experience in this matter and this, of course, has a negative influence on the steel to be cast therein. He calls for constant study of world technical literature in this matter and draws attention to the fact that since 1958 interesting experiments have been made in the USSR in producing ingot moulds from blast furnace crude and from spheroidal graphite cast iron. Experiments carried out in France show that one important factor affecting the life span of ingot moulds is the relationship between their weight and the weight of the ingot. The ideal weight relation-

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ship between mould and ingot is, according to the author, about 1.0 to 1.1. Other experiments carried out in France have shown that another important factor is the Si and Mn content of the mould's cast iron, the ideal proportion being about 2.46 Si to 4.25 Mn. Soviet engineers have reached the following conclusions in this respect: the first sign that the mould is wearing out is the formation of a network of superficial cracks on the internal surface; these cracks are mostly due to tensions caused during cooling; these may be eliminated by giving the moulds a higher Cr and Ni content but this raises the danger of lengthwise cracks in the mould; the best material by far is spheroidal graphite cast iron; moulds may also be made from blast furnace crude which is readily available on the spot and hence production costs are relatively low; finally, the thickness of the mould's walls should be uniform and reinforcing ribs should be added, these structural changes greatly increasing the life span of ingot moulds. There are 10 references, 8 of which are Soviet, 1 French and 1 English.

RADZWICKI, K., doc.

Development of the oxidizing converter process during the years 1959 - 1960. Hutnik P 28 no.7/8:300-303 Jl-Ag '61.

RADZWICKI, K., doc.

Intensification of the open-hearth process in the light of publications issued in the years 1960 and 1961. Hutnik P 29 no.9:349-352 S '62.

RADZWICKI, Kazimierz, doc. mgr. inz.

What type of steel works is the most proper one for the Polish metallurgical industry? Wiad hut 17 no.9:256-259 S '61.

RADZWICKI, Kazimierz, doc. mgr inż.

Advantages obtained by applying the metallurgical blast cupola in plants with incomplete production cycles. Wiad hut 18 no.7/8:204-208 Jl-Ag '62.

18(5)

AUTHOR: Kuliński, Z., Paczuła, B., Mechanical Engineers and Radźwicki, K., Mechanical Engineer, Lotsent

TITLE: Production of Metallic Manganese from Waste Products (Wytwarzanie manganu metalicznego z surowców odpadowych)

PERIODICAL: Hutnik, 1958, Vol 25, Nr 11-12, pp 471-477 (Poland)

ABSTRACT: The shortage of manganese in the world market has been increasing for years. Imports of manganese into Poland are inadequate. This raises the question of the extraction of manganese from manganic muds, which have been a waste product of the pharmaceutical industry. Basically, there exist three methods for the production of metallic manganese: 1) electrothermic, 2) aluminothermic, and 3) electrolytic. The electrothermic method is seldom used. The aluminothermic method consists in the exothermic reduction of manganic oxides with granulated aluminum. Aluminothermic reactions are: $3MnO_2 + 4Al = 3Mn + 2Al_2O_3$

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$3Mn_3O_4 - 8Al = 9\ Mn - 4\ Al_2O_3$

$Q_{(1)}$ = 1147.4 cal/g; $Q_{(2)}$ = 665.1 cal/g. The electrolytic method employs the electrolysis of $MnSO_4$ in the presence of ammonium salts. The Institute of Iron Metallurgy, Gliwice, and the Academy of Mining and Metallurgy carried out research and experiments regarding the enrichment, cleaning and preparation of manganic mud for metallothermic use. While the metallothermic extraction of manganese from pretreated manganic muds did not give a good yield, the results of the metallothermic melting of raw, dried manganic mud were quite satisfactory. A manganese of higher purity was obtained than the standard electrothermic manganese. Although 0.274 kg of granulated aluminum is needed to reduce 1 kg of manganic mud with 42% Mn content, the extracted manganese is cheaper than the imported one. It has been calculated that the Cracow Pharmaceutical Works will yield in the years to come about 1,200 tons of manganic mud, from which 240 tons of metallic manga-

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nese can be extracted. There are 8 tables, 4 graphs and 3 references, 1 of which is Polish, 1 German and 1 Soviet.

ASSOCIATION: Instytut metalurgii żelaza - Gliwice (Institute of Iron Metallurgy, Gliwice)

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PADZIOCH, K.

Possibilities of reducing the use of electric power in arc furnaces. p. 8

HUTNIK. (Panstwowe Wydawnictwa Techniczne) Vol. 26, no. 1, 1959 Katowice, Poland

Monthly List of East European Accession (EEAI) LC, Vol. 8 no . 7, July 1959

Uncl.

18(5)
AUTHOR: Radźwicki, K.

TITLE: Increase in Steel Production by Heating of Deadhead (Zwiększenie uzysku stali przez nagrzewanie nadlewu wlewka)

PERIODICAL: Hutnik, 1958, Vol 25, Nr 11-12, pp 511-512 (Poland)

ABSTRACT: Heating deadheads by means of an electric arc or a gas burner takes too much time and is often impracticable. The simple and cheap method of Khvorinov, used instead at the Soviet "Serp i Molot" works, consists in strewing an exothermic compound on the surface of the ingot and blowing oxygen on it. As a result, the exothermic compound burns on the surface of the deadhead and provides thereby a considerable amount of heat. The following compounds are used: (1) pulverized 75 per cent ferrosilicon 70%, soda saltpeter 20%, chamotte flour 10%; or (2) 75 per cent ferrosilicon 70%, soda saltpeter 20%, siliceous limestone 10%. The grain of the ground ferrosilicon, which is used in the proportion

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of 1.0 to 1.2 kg per ton of steel, must not exceed 2 mm. The pressure of the oxygen must not be higher than 4 or 5 at; it is blown 2 to 3 minutes. The method of Khvorinov has been used at the "Serp i Molot" works on over 200,000 tons of steel already. The article is based on a report of N.P.Zhetvin, V.P.Tunkov and A.D.Zaytseva in "Stal'", 1957, Nr 7.

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18(5)

AUTHOR: Kuliński, Z., Paczuła, B., Mechanical Engineers and Radźwicki, K., Mechanical Engineer, Lotsent

TITLE: Production of Metallic Manganese from Waste Products (Wytwarzanie manganu metalicznego z surowców odpadowych)

PERIODICAL: Hutnik, 1958, Vol 25, Nr 11-12, pp 471-477 (Poland)

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Production of Metallic Manganese from Waste Products

$3Mn_3O_4 - 8Al = 9\ Mn - 4\ Al_2O_3$

$Q(1) = 1147.4$ cal/g; $Q(2) = 665.1$ cal/g. The electrolytic method employs the electrolysis of $MnSO_4$ in the presence of ammonium salts. The Institute of Iron Metallurgy, Gliwice, and the Academy of Mining and Metallurgy carried out research and experiments regarding the enrichment, cleaning and preparation of manganic mud for metallothermic use. While the metallothermic extraction of manganese from pretreated manganic muds did not give a good yield, the results of the metallothermic melting of raw, dried manganic mud were quite satisfactory. A manganese of higher purity was obtained than the standard electrothermic manganese. Although 0.274 kg of granulated aluminum is needed to reduce 1 kg of manganic mud with 42% Mn content, the extracted manganese is cheaper than the imported one. It has been calculated that the Cracow Pharmaceutical Works will yield in the years to come about 1,200 tons of manganic mud, from which 240 tons of metallic manga-

Production of Metallic Manganese from Waste Products

nese can be extracted. There are 8 tables, 4 graphs and 3 references, 1 of which is Polish, 1 German and 1 Soviet.

ASSOCIATION: Instytut metalurgii żelaza - Gliwice (Institute of Iron Metallurgy, Gliwice)

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POL/39-25-11-15/26

24(8)
AUTHOR: Radźwicki, K.

TITLE: Improvement of Steel by Degassing It in a Vacuum and Pouring It in Protective Atmosphere (Polepszenie jakości stali przed odgazowywanie w próżni oraz odlewanie w atmosferze ochronnej)

PERIODICAL: Hutnik, 1958, Vol 25, Nr 11-12, pp 505-509 (Poland)

ABSTRACT: The article is based on a report by L.M.Novik in the collection of reports "Primeneniye vakuuma v stale-plavilnykh protsessakh", Moscow 1957. Thermodynamic calculations and experience show carbon to be, under atmospheric pressure, a weaker deoxidizer of liquid metal than silicon and aluminum. But carbon has the advantage of yielding gas products separating completely from the metal, and its deoxidizing capacity can be increased 10 times by lowering the outside pressure to 0.1 at, 760 times by lowering it to 1 mm Hg. Deoxidizing steel by carbon in a vacuum can reduce its carbon content to 0.02%, or even to 0.01%. At the same time,

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both hydrogen and nitrogen are separated from steel because their dissolubility in steel is directly proportionate to the square root of the partial pressure of these gases above the metal. As a rule, the degassing of metal in a vacuum chamber lasts 10 to 20 minutes, so the chamber must be operated easily and quickly. The article proceeds to describe various degassing vacuum chambers now in use in the Soviet Union. After degassing in a vacuum, unkilled steel contains 4 to 10 times less oxygen than undegassed unkilled steel, or about as much oxygen as ordinary killed steel contains (0.0044 to 0.0053% O). The nitrogen content of vacuum-degassed unkilled steel amounts to 30-50% as compared with the nitrogen content before degassing. Ingots of vacuum-degassed unkilled steel are similar to ingots of killed steel in structure and degree of heterogeneity. converted (Bessemer) steel has a low impact strength at temperatures below 0°C and ages easily; if degassed in a vacuum, it retains a high impact strength even at -60° C. Experiments have shown that degassing unkilled steel

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in a vacuum can reduce within 5 to 7 minutes its initial 0.10 to 0.15% carbon content to 0.02%. Similar results are obtained by degassing in a vacuum electric alloy steels. Used on chrome-nickel steel, this process reduces drastically the number of fine cracks in it and eliminates its tendency to scaling. To prevent a secondary oxidation, the degassed metal should be poured in a protective atmosphere, without direct contact with ambient air. This is especially important in case of high-grade alloy steels. There are 8 diagrams, 1 graph and 1 photograph.

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18(5)

AUTHOR: Radźwicki, K.

TITLE: Increase in Steel Production by Heating of Deadhead (Zwiększenie uzysku stali przez nagrzewanie nadlewu wlewka)

PERIODICAL: Hutnik, 1958, Vol 25, Nr 11-12, pp 511-512 (Poland)

ABSTRACT: Heating deadheads by means of an electric arc or a gas burner takes too much time and is often impracticable. The simple and cheap method of Khvorinov, used instead at the Soviet "Serp i Molot" works, consists in strewing an exothermic compound on the surface of the ingot and blowing oxygen on it. As a result, the exothermic compound burns on the surface of the deadhead and provides thereby a considerable amount of heat. The following compounds are used: (1) pulverized 75 per cent ferrosilicon 70%, soda saltpeter 20%, chamotte flour 10%; or (2) 75 per cent ferrosilicon 70%, soda saltpeter 20%, siliceous limestone 10%. The grain of the ground ferrosilicon, which is used in the proportion

Increase in Steel Production by Heating of Deadhead

of 1.0 to 1.2 kg per ton of steel, must not exceed 2 mm. The pressure of the oxygen must not be higher than 4 or 5 at; it is blown 2 to 3 minutes. The method of Khvorinov has been used at the "Serp i Molot" works on over 200,000 tons of steel already. The article is based on a report of N.P.Zhetvin, V.P.Tunkov and A.D.Zaytseva in "Stal'", 1957, Nr 7.

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PGL/39-59-4-8/14

18(5,7)

AUTHOR: Radzwicki, K

TITLE: The Development of Vacuum Metallurgy and Casting in a Sheltered Atmosphere

PERIODICAL: Hutnik, 1959, Nr 4, pp 165-167 (Poland)

ABSTRACT: All metals in the liquid state tend to dissolve gases in varying degrees. This depends on such factors as the properties of the respective metals and gases, the pressures and temprerawures involved and the length of time during which metals and gases are in contact. It may generally be said that the hotter the metals, the more gas it will absorb. This of course has a detrimental influence on its properties as a metals in the solid state. Gases given off during cooling also effects the metals structure, causing blisters, pores, cavities etc. The need to do away with these flaws is all the greater in view of the ever-rising demand for high-quality metals. Vacuum processes have been developed in recent years above

The Development of Vacuum Metallurgy and Casting in a Sheltered Atmosphere

all in the USA. Table 1 shows expansion in this field from 1957 to 1958. The table gives capacity figures for the three main vacuum processes: degasifying in vacuum chambers, melting and casting in a vacuum, using respectively induction and arc furnaces. Table 2 shows the degree of degasification achieved by these three methods for soft steel and stainless steel respectively. The cheapest of the three methods is the use of a vacuum chamber for degasifying. Even then costs are increased by about 8-9 dollars per ton. The induction furnaces system is the least economic, since the apparatus is expensive and its capacity is relatively small. One economic method is to cast in a sheltered atmosphere, in this case nitrogen which is fairly cheap and readily available. About 0.4 m^3 of this gas are required per ton. Though nitrogen casting is certainly no replacement for the vacuum processes, it at least eliminates surface flaws. There are 2

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POL/39-59-4-8/14

The Development of Vacuum Metallurgy and Casting in a Sheltered Atmosphere

tables and 7 references 2 of which are Soviet, 3 English, 1 German and 1 Polish

Card 3/3

RADZWICKI, K., doc.

Increase of steel yield from ingots. Hutnik P 28 no.9:347-349 S '61.

Influence of degasification of liquid steel in vacuum upon its hydrogen content. Ibid.:349-351

RADZWICKI, Kazimierz, doc.

Present state of using oxygen in open-hearth furnaces. Wiad hut 19 no.10:282-285 O '63

RADZWIECKI, K., doc.

Melting metals in electron stream. Hutnik P 29 no.11:432-438 N '62.

18(3,5,7) POL/39-59-7/8-2/24

AUTHOR: Radźwicki, Kazimierz, Docent, Master of Engineering

TITLE: The Influence of Vacuum Casting on the Structure and Forgeability of High Nickel Steel Ingots

PERIODICAL: Hutnik, 1959, Nr 7-8, pp 262-267 (POL)

ABSTRACT: High nickel steels are not well suited to modification processes. It may be said in general that the higher the nickel content, the worse the surface of billets after thermal modification or treatment, especially after rolling. There are several reasons for this. If high nickel steel contains sulphur to any significant degree, the nickel and sulphur tend to form a eutectic mixture with a low melting point which may in turn lead to brittleness at high temperatures. Fracturing or brittleness of high nickel steel ingots may be prevented by very careful heating before thermal treatment. A more harmful component of high nickel steel is hydrogen. Nickel even in the solid state tends to dissolve hydrogen rather easily. This often leads to internal blisters and cracks in ingots. The

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The Influence of Vacuum Casting on the Structure and Forgeability of High Nickel Steel Ingots

greatest care should therefore be taken in producing high nickel steel to take all measures designed to keep hydrogen content to a minimum. Another reason for flaws in high nickel steel ingots may be simply penetration of oxygen and sulphur from the air during casting. As a result of these considerations, the Ferrous Metallurgy Institute at Gliwice decided to experiment with vacuum casting of high nickel steel ingots. This was done using a basic arc furnace with a capacity of 250 kg, ingot moulds of 125 kg capacity and with an alloy containing about 0.08% carbon and about 36% nickel. Test forging was then carried out at exactly the same time and in exactly the same way as with steel ingots of the same composition cast under atmospheric pressure. The chemical composition of test ingots is given in table 1. Figures 1, 3, and 5 show the structure of ingots cast under atmospheric pressure, and figures 2 and 4, the cross sections of vacuum cast ingots. Table 2 gives the per-

centage forging yield from the first series of tests. Tables 3 and 4 give the same information as tables 1 and 2, but for the second series of tests. The author reaches the following conclusions from these experiments: it was found that vacuum casting completely eliminates the problem of swelling of ingots, even when their composition was least favorable, i.e. low carbon, manganese and silicon content. It was further found that vacuum casting radically reduces the extent of the zone of transcrystallization, thus improving the ingot's qualities. This is important, since extensive transcrystallization is one of the main reasons for poor forgeability of high nickel steel ingots. The tests confirmed that ingots with increased sulphur content, though not ideally suited for forging, can be successfully treated in this way if forging is carried out with care. Vacuum casting also tends to decrease the amount of cracks and blisters apparent in ingots cast under atmospheric pressure

The Influence of Vacuum Casting on the Structure and Forgeability of High Nickel Steel Ingots

and then forged in the normal manner. The author stresses in conclusion, that the experiments carried out as described above did not yield enough statistical data to arrive at any irrevocable conclusions. The conclusions drawn seem to indicate in a general manner, however, that vacuum casting does improve the forgeability of high nickel steel ingots. There are 4 tables, 5 photographs, and 6 references, 3 of which are German, 2 Polish, and 1 Czech.

ASSOCIATION: Instytut metalurgii żelaza, Gliwice (Institute of Ferrous Metallurgy, Gliwice)

POL/39-59-12-4/16

25(1)

AUTHOR: Radźwicki, Kazimierz, Docent, Master of Engineering

TITLE: Production of more Wear-Resistant and Durable Rails

PERIODICAL: Hutnik, 1959, Nr 12, pp 496-498 (Poland)

ABSTRACT: Steel rails produced in Poland today, containing up to 0.6% C and up to 0.9% Mn, are obsolete in view of higher load requirements and transportation running speeds. Research in the USA and the Soviet Union has indicated that it is advantageous to raise C content to 0.6-0.3% when Mn content is in the 0.6-1.0% range. Tests have shown that wearability can be reduced threefold by increasing the content of the D factor (% C + 0.25% Mn) from 0.73 to 0.99. Another way to increase durability is to adopt the heavier, Soviet-style profiles. Twofold to fourfold lifespan increases have been achieved in this way and this would justify the 30-50% weight increase involved. But both these solutions present difficulties since in both cases the tendency to steel flaking is significantly increased.

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Production of more Wear-Resistant and Durable Rails

To prevent this, two methods have been evolved abroad, namely isothermic annealing for 3 hours at 600°C in special furnaces immediately after rolling; and continuous slow cooling in air to 400°C and then in insulated and controlled surrounding to 150°C over a period of several hours. In order to improve rail quality, it has become a rule in the USSR to cast rail ingots exclusively in funnel-shaped, hot-top moulds. This solution, too, is impractical in Polish conditions in view of the physical state of most steel mills, lacking as they do sufficient space for the construction of improved rolling facilities and cooling pits. The author considers that an earnest attempt should be made to study the method of degassing liquid rail steel in vacuum chambers in view of its future large-scale application. Experiments with this method have given good results and the Soviet scientist Samarin has noted twofold decreases in H content, up to eightfold decreases in O content and up to 20% decreases in

Production of more Wear-Resistant and Durable Rails

N content. This method of degassing has also led to improvements in the mechanical properties of steel. Experiments were carried out with a 16-ton ladle in a vacuum chamber, degassing time being 12-14 minutes and pressure 70-100 mm Hg. In the author's opinion, an installation of this kind would cost 0.5-1 million zloty and this would certainly be cheaper than the construction of cooling pits. There are 3 references, 2 of which are Soviet and 1 English.

ASSOCIATION: Instytut Metalurgii Zelaza (Institute of Iron Metallurgy, Gliwice).

RADZWICKI, Kazimierz, doc.

High pressure smelting of alloy steel containing nitrogen.
Wiad hut 15 [i.e. 20] no.5:134-135 My '64.

25(1) POL/39-59-12-4/16

AUTHOR: Radźwicki, Kazimierz, Docent, Master of Engineering

TITLE: Production of more Wear-Resistant and Durable Rails

PERIODICAL: Hutnik, 1959, Nr 12, pp 496-498 (Poland)

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Production of more Wear-Resistant and Durable Rails

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Production of more Wear-Resistant and Durable Rails

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ASSOCIATION: Instytut Metalurgii Zelaza (Institute of Iron Metallurgy, Gliwice).

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18(5,7) POL/39-59-11-3/16

AUTHOR: Radzwicki, Kazimierz, Docent, Master of Engineering

TITLE: Refractory Materials in View of Technical Progress in Steel Metallurgy

PERIODICAL: Hutnik, 1959, Nr 11, pp 441-443 (POL)

ABSTRACT: The author describes the progress in steel making techniques after WW II, when it was found out that high grade steel can be produced in Bessemer converters when oxygen is used in the process. Oxygen reduces the phophorus content in steel. A finishing oxygen and water vapor blast in converters keeps the nitrogen content within 0.002-0.004% which is considerably less than the nitrogen content in open hearth steel (0.004-0.007%). The author further states that the use of oxygen in open hearth and electric arc furnaces also improves the quality of steel and production efficiency. However, the use of oxygen in the steel making process causes a considerable rise in temperature which in turn calls for better refractory materials. Further, the problem of finding proper refractory materials for open hearth furnaces (silicate bricks, basic chrome-magnesite materials

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Refractory Materials in View of Technical Progress in Steel Metallurgy

of improved quality), electric furnaces (improved silicate materials and special lining materials, prefabricated lining for repair) and for casting ladles is presented. Oxygen converters will be built in two Polish steel plants in near future, and a 5-ton experimental converter will most probably be in operation in 1960. An experimental 10-ton turbo open hearth converter (with a side blast of pressurized air) is in operation at the "Bobrek" Steel Plant. The Instytut materialow ogniotrwalych (Institute of Refractory Materials) has to design durable blast nozzles for turbo open hearth converters. It is suggested that production of mono-block nozzle units should be started instead of sub-assembled nozzles. A four-line continous steel casting installation is scheduled to be operative in Poland in 1961 and produce blooms for tube production. An experimental continous casting installation for high grade steel will probably be in operation in 1960. Proper lining for the casting ladles will have to be developed by the

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Refractory Materials in View of Technical Progress in Steel Metallurgy

Instytut metalurgii zelaza (Institute of Iron Metallurgy) in cooperation with the Institute of Refractory Materials. At the close, the author points out that degasing liquid steel in a vacuum also requires proper refractory materials which must have good thermal isolation qualities along with low porosity. Conjunction of these two qualities constitutes a problem.

ASSOCIATION: Instytut metalurgii zelaza (Institute of Iron Metallurgy) Gliwice.

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RA.ZWICKI, K.; MATKANIEC, J.

Oxygen converter process; the Lonz and Donawitz process. p. 28.

(PRZEGLAD TECHNICZNY, Vol. 74, No. 1, Jan. 1957, Katowice, Poland.)

SO: Monthly List of East European Accessions (EEAL) LC. Vol. 6, No. 10, October 1957. Uncl.

RADZWICKI, K; BRATKOWSKI, S.

Technology of founding half-quenched steel containing less carbon than 0.30 0/0.

Biuletyn. p. 37.

HUTNIK, Vol. 22, No. 10 October, 1955

(Panstwowe Wydawnictwa Techniczne) Katowice

SOURCE: EAST EUROPEAN ACCESSIONS LIST Vol. 5, No. 1 Jan. 1956

RADZ : CKI, K.

Origin of nonmetallic elements in steel for journal bearings. p. 377.

HUTNIK, Vol. 22, No. 10 October, 1955

(Panstwowe Wydawnictwa Techniczne) Katowice

SOURCE: EAST EUROPEAN ACCESSIONS LIST Vol. 5, No. 1 Jan. 1956

RADZIKI, KAZIMIERZ, ed.

Kontrola jakości produkcji w hutnictwie żelaza; praca zbiorowa. (Wyd. 1.) Stalinogród, Wydawn. Górniczo-Hutnicze, 1955. 481 p. (Control of the quality of production in iron metallurgy; a collective work. 1st ed. illus., bibl., diagrs., footnotes, graphs)

So: Eastern European Accession. Vol 5, no. 4, April 1956

RADZ:ICKI, K.

Time studies on units of work in a blast-furnace foundry.

p. 114
Vol. 21, no. 4, Apr. 1954
HUTNIK
Katowice

SO: Monthly List of East European Accessions (EEAL), LC, Vol. 5, no. 2
Feb. 1956

Radzwicki, K.

Influence of carbon monoxide blasted in electric-arc furnaces on the quality of steel p. 177, Vol. 22, no. 5, May 1955, HUTNIK

SO: MONTHLY LIST OF EAST EUROPEAN ACCESSIONS, (EEAL), Vol. 4, LC, No.9, Sept. 1955, Uncl.

Radzwicki, K.

Intensifying steel founding processes. p164, Vol. 22, no. 5, May 1955, HUTNIK

SO: MONTHLY LIST OF EAST EUROPEAN ACCESSIONS, (EEAL), Vol. 4, LC, No.9, Sept. 1955, Uncl.

RADZIWICKI, K.

Intensification of Steelmaking Processes. K. Radziwicki. (*Hutnik*, 1955, 22, (5), 164–171). [In Polish]. The use of oxygen for the intensification of the O.H. process is outlined. The use of the air-blown convertor and L.D. process for steelmaking is described.—v. o.

RADZWICKI, K. & BRATKOWSKI, S.:

Technology of the production of semi-killed steel of a carbon content below 0.30%.
By K. Radziwicki and S. Bratkowski ...

SO: Hutnik, #10, Oct 55, pp 37-39 Appendix.

RADZWICKI, K.:

The origin of non-metallic intrusions in steel for machined bearings. (from Izv.Ak.Nauk, Otd.Tekhn.Nauk, 1955, No. 3, pp. 91-101).
By K. Radzwicki ...

SO: Hutnik, #10, Oct 55, pp349-392, & Appen.

RADZWICKI, K.

Inst. (3)

Fuel Abst.
Vol. 15
Jan. 1954
Industrial Furnaces, Kilns, etc; Combustion

690. DIFFUSION DEOXIDATION WITH COKE IN BASIC OPEN HEARTH FURNACE. Radzwicki, K. and Kozielski, J. (Prace GIMO (Contr. Chief Inst. Metallurg. Found.), 1951, 267-277; abstr. in Chem. Abstr., 1953, vol. 47, 7391).
The application of diffusion deoxidation with coke in basic open hearth furnaces lead the authors to the following conclusions: (1) This method is more efficient than is the sedimentation method; (2) coke addition does not result in introduction of additional phosphorus or carbon, (3) steel output is greater and cost of cleaning of semi-finished product is lower; (4) duration of the whole process remains unaffected; (5) the method gives great savings in deoxidizers and ferro-alloys. C.A.

RADZ[illegible]ICKI, K.

(EUTNIK, Vol. 20, No. 11, Nov. 1953, Katowice, Poland)
"How steel should be poured into molds; from the top or from the bottom?" p. 349

SO: MONTHLY LIST OF EAST EUROPEAN ACCESSIONS, L.C., Vol. 3, No. 4, APRIL 1954

RADZWICKI, K.

Chemical Abst.
Vol. 48 No. 8
Apr. 25, 1954
Metallurgy and Metallography

Reclaiming of high-speed steel by remelting scrap in an arc furnace. K. Radzwicki. *Prace Inst. Ministerstwa Hutnic* 5, 113–18 (1953).—Investigation showed that the most economical method of reclaiming valuable addns. contained in high-speed steel scrap is to use a charge consisting of 100 units of scrap and 5 units of mill scale from high-speed steel.
M. O. Holowaty

RADZIWIŁŁOWICZ, K.

"Choosing the Most Proper Method of Deoxidizing High-speed Cutting Steel in an Electric Arc Furnace." Biuletyn Informacyjny. p. 25 (HUTNIK, Vol. 20, No. 7, July 1953) Warszawa

SO: Monthly List of East European Accessions, Library of Congress, Vol. 2, No. 10 October 1953. Unclassified.

RADZWICKI , K.

"Increasing the Efficiency of Open-Hearth Furnaces" p. 4 (Wiadomosci Hutnicze, Vol. 9, No. 4, Apr., 1953, Stalinogrod)

SO: Monthly List of East European Accessions, Vol. 3, No. 2, Library of Congress, February, 1954, Uncl.

(1)
2

The Choice of Deoxidation Method for High-Speed Steels in a Basic Electric Arc Furnace. K. Radzwicki. (*Biuletyn Informacyjny Instytutow Ministerstwa Hutnictwa*, 1953, 4, (7), 25–28 ; *Hutnik*, 1953, 20, (7)). [In Polish]. Three methods of deoxidizing high-speed steel were tested : (1) Deoxidation under a white slag by adding electrode carbon powder ; (2) deoxidation under a carbide slag ; and (3) two-stage deoxidation under a white slag first with carbon powder and then with powdered ferrosilicon. The structure, quantity of non-metallic inclusions, and cutting properties of steels produced by these methods were examined. The steel produced by all three methods was of equal quality, but for economic and technical reasons the third method is most suitable because the finishing stage is shorter and the electricity consumption is smaller.—v. g.

mat. (3)

RADZWICHI, K.

Fuel Abst.
Vol. 15
Jan. 1954
Industrial Furnaces, Kilns, etc; Combustion

690. DIFFUSION DEOXIDATION WITH COKE IN BASIC OPEN HEARTH FURNACE. Radzwicki, K. and Kozielski, J. (Prace GIMO (Contr. Chief Inst. Metallurg. Found.), 1951, 267-277; abstr. in Chem. Abstr., 1953, vol. 47, 7391). The application of diffusion deoxidation with coke in basic open hearth furnaces lead the authors to the following conclusions: (1) This method is more efficient than is the sedimentation method; (2) coke addition does not result in introduction of additional phosphorus or carbon, (3) steel output is greater and cost of cleaning of semi-finished product is lower; (4) duration of the whole process remains unaffected; (5) the method gives great savings in deoxidizers and ferro-alloys. C.A.

Y Met (2)

BTR, v. 3, Feb 1954 Metallurgy

✓2242* Reclaiming Melts of High-Speed Steel Waste in an Electric Arc Furnace. (Polish.) K. Radzwicki, *Prace Instytutow Ministerstwa Hutnictwa*, v. 5, no. 3, 1953, p. 113-118.

Discusses reclaiming melting entirely without oxidizing and with partial oxidizing. Describes advantages of adding high-speed steel cinder to the charge. Tables. 7 ref.

RADZWICKI, K.

Utilization of coke in the basic open-hearth furnace / K. Radzwicki and J. Kozielski (Hutnik, Warsaw, 1951, 5, 267-271).

Addition to coke to the slag layer does not lead to increased C or P contents of the steel, or to formation of nonmetallic inclusions, whilst at the same time the Fe content of the slag falls, and the consumption of Mn is halved. The process is more economical in labour and materials that is the electric-hearth one, whilst the quality of the products is the same. R. Truscoe.

RADZWICKI, K.

(Polish) K. Radzwicki, J. [illegible], and W. [illegible]: "[illegible] [illegible] Films for Steel Plates." (Prace Glownego Instytutu Metalurgii, [illegible], No. 3, pp. [illegible].)

Immediate source clipping

RADZWICKI, K.

Over

Briquetting of Ores Fines for Steel Plants. K. Radzwicki, W. Madej, and W. Stronczak. (*Prace Glownego Inst. Met.*, 1951, No. 3, 173–181). [In Polish]. Very good results were obtained in briquetting ore concentrates by Jarcho's method (used in U.S.S.R.) in which fines are mixed with small amounts of iron filings, water, and sodium chloride (0·5–1%). The method is based on corrosion processes which bind ore particles together. The highest strength of briquettes and the shortest time of hardening are obtained when the components are mixed so as to obtain the highest temperature increase during the corrosion process. Best results are obtained if the mix is pressed when at its highest temperature. However, sodium chloride is objectionable due to the destructive influence of alkali on refractory linings. Experiments were therefore made in which CaO, HCl, $MgCl_2$, H_2SO_4, ferrous sulphate, and spent pickling liquor were used as substitutes for sodium chloride. Investigations were made with ore concentrates containing Fe 71·2%, SiO_2 1·57%, CaO 2·29%, MgO 0·43%, P 0·13%, and S 0·039%. In laboratory experiments cylindrical briquettes (dia. and height about 50 mm., weight about 400 g.) were made at a pressure of 250 kg./sq. cm. Industrial briquettes (250 × 130 × 65 mm. weighing 6–7 kg.) were made on a brick-making machine at the same pressure. Fresh briquettes were left in the air under cover, and samples were tested every day for strength to follow the process of hardening. Minimum requirements for a briquette were taken from Russian practice, namely: (1) Compression strength min. 50 kg./sq. cm.; (2) shatter test: a briquette dropped twice on a steel plate from a height of 2 m. must not produce more than 10% fines (below 5 mm.); (3) porosity not more than 5–10%; (4) briquettes must not crumble when

RADZWICKI, Kazimierz, doc.

Smelting of stainless chromium-nickel steel containing 0.03% C. Wiad hut 19 no. 6: 149-151 Je '63.

RADZWICKI, Kazimierz, doc. mgr inz.

Desulfurization of pig iron independently of blast furnaces. Wiad hut 15 [i.e. 20] no. 2: 39-41 F '64.

P/043/60/000/011/002/002
A223/A026

AUTHOR: Radźwicki, Kazimierz, Docent, Master of Engineering

TITLE: Vacuum Degassing of Liquid Steel and the Selection of the Most Suitable Degassing Method

PERIODICAL: Wiadomości Hutnicze, 1960, No. 11, pp. 342 - 345

TEXT: The ever-increasing demand for steel of higher purity and better mechanical properties calls for effective methods, which will reduce gas and impurities content of steel. During the last few years the vacuum degassing method has been widely used. There are three basic vacuum degassing method in use today, i. e. 1) degassing in the casting ladle, in three versions: a) by the fraction-method; b) by the circulation method and c) by the vacuum-chamber method; 2) degassing during the pouring of steel from the ladle at workroom temperature to another ladle placed in a vacuum and 3) degassing during the pouring of steel from the ladle at workroom temperature into the mold placed in a vacuum. The degassing by the fraction-method is presented in Figure 1. This method reduces the oxygen content by 50 - 60%, the hydrogen content by 40% and the nitrogen content by 15 - 20%. The main advantage of this method is that the metal can be degassed before the deoxidizing process and the deoxidizing process is applied in the final degassing phase. This makes

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Vacuum Degassing of Liquid Steel and the Selection of the Most Suitable Degassing Method

for a small amount of deoxidizing agents and a small amount of resulting deoxidizing products. However, the method has considerable draw-backs, i.e. 1) the high cost of heating the vacuum chamber before and during the degassing process; 2) since the already-degassed steel drops to the bottom of the ladle by passing through steel not yet degassed there is a danger of the degassed steel becoming re-gassed and 3) steel degassed by this method is cast into mold at workroom temperature which makes for re-gassing of degassed steel. The degassing method by circulation is shown in Figure 3. The results as well as the advantages and disadvantages of the version are similar to those of the fraction-method. The degassing in vacuum chamber is shown in Figure 4. This is the cheapest and the simplest degassing method and also the most suitable one for such products as rails with over 75 kg/mm^2 cold-rolled strip etc. Up to recently the degassing of steel in vacuum widely practised in the West raised doubts concerning its effectiveness. These doubts were justifiably caused by the low-productivity vacuum pumps which have a working pressure rarely below 35 Tr during the degassing process. At present with the pressure in the vacuum chamber being decreased by several Tr, as shown by German research, this method is becoming not only the most effective one but also the one making for a complete uniformity

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of degassing in metal. The method of degassing steel during the pouring from the ladle at workroom temperature into a ladle placed in a vacuum is shown in Figure 5 and is based on stream degassing. The oxygen content is reduced by this process by 80%, the hydrogen content by 50 - 60% and the nitrogen content by about 30%. The disadvantages of this method are 1) loss of heat during the transfer of steel from one ladle to the other and 2) danger of regassing of steel during the casting into molds. The author maintains, however, that this method is suitable for transformer steels since the silicon iron added to the steel in vacuum compensates for the heat losses in the second ladle. The method of degassing steel during the casting into molds placed in vacuum is shown in Figures 6 and 7. This method is suitable for steels which have already been subjected to all other necessary processes. The low hydrogen content of this steel makes it suitable for heavy forgings which otherwise show a tendency to flaking. The tendency is not fully eliminated by this process since, according to the experience of American steel plants, only a decrease in the hydrogen content up to 1.5 $cm^3/100$ g allows a shorter heat treatment of forgings. Therefore, if the hydrogen content can be decreased to a minimum of 80% in relation to the original content before degassing, the original hydrogen content of steel must not be higher than 7 cm^3 per 100 g. There are 7 figures and 6 references.

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P/043/60/000/011/002/002
A223/A026

Vacuum Degassing of Liquid Steel and the Selection of the Most Suitable Degassing Method

3 German, 2 English and 1 Soviet.

Card 4/4

RADZWICKI, Kazimierz, doc. mgr inz.

Possibility, from the practical point of view, of competition between a steel works equipped with open-hearth furnaces and a steel works operating by the oxygen converter gas method? Wiad hut 15 no.11:339-340 N '64.

RADZWICKI, R.

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13449 Degassing of Steel in Vacuum. H. Zakrzwa and R. Radzwicki. *Henry Brutcher Translation No.* 3921, 9 p. (From *Biuletyn Informacyjny, Hutnik, Poland*), v. 7, no. 11, 1956, p. 41-45.) Henry Brutcher, Altadena, Calif.

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